

**FINAL REPORT
SEPTEMBER 2005**

REPORT NO. 05-19B



**TRANSPORTABILITY TESTING OF THE
120MM COMPOSITE MONOPACK PALLET,
TP-94-01, Rev. 2, JUNE 2004
"TRANSPORTABILITY TESTING PROCEDURES"**

Prepared for:

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ARDEC
Logistics Research and Development Activity
ATTN: AMSRD-AAR-AIL-P
Picatinny Arsenal, NJ 07806



**DEFENSE AMMUNITION CENTER
VALIDATION ENGINEERING DIVISION
MCALESTER, OKLAHOMA 74501-9053**

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TRANSPORTABILITY TESTING OF THE 120MM
COMPOSITE MONOPACK PALLET,
TP-94-01, REV. 2, JUNE 2004, "TRANSPORTABILITY TESTING
PROCEDURES"

SEPTEMBER 2005

ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMAC-DEV), was tasked by the Logistics Research and Development Activity (AMSRD-AAR-AIL-P), Picatinny, NJ to conduct transportability testing on the 120MM Composite Monopack Pallets. The testing was conducted in accordance with TP-94-01, Revision 2, June 2004 "Transportability Testing Procedures."

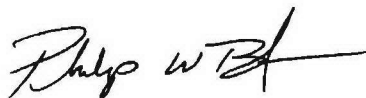
The objective of the testing was to evaluate the 120MM Composite Monopack Pallets, when transportability tested in accordance with TP-94-01, Revision 2, June 2004.

The 120MM Composite Monopack Pallet is adequate to be transported in an intermodal container.


During the rail impact testing in a boxcar the compression of the 120MM Composite Monopack Pallets was excessive and caused the pallets to bow upward and caused damage to one top pallet. There was also excessive movement of the 120MM Composite Monopack Pallets during testing. Therefore, the 120MM Composite Monopack Pallet stacked two high is **not adequate** to be transported by rail in a boxcar.

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**VALIDATION ENGINEERING DIVISION
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REPORT NO. 5-19B

**Transportability Testing of the 120MM Composite Monopack Pallet,
TP-94-01, Revision 2, June 2004 "Transportability Testing Procedures"**

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PART 1 – INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMAC-DEV), was tasked by the Logistics Research and Development Activity (AMSRD-AAR-AIL-P), Picatinny, NJ to conduct transportability testing on the 120MM Composite Monopack Pallet. The testing was conducted in accordance with TP-94-01, Revision 2, June 2004 “Transportability Testing Procedures.”

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Joint Munitions Command (JMC), Rock Island, IL. Reference is made to the following:

1. AR 740-1, 15 June 2001, Storage and Supply Activity Operation.
2. OSC-R, 10-23, Mission and Major Functions of U.S. Army Defense Ammunition Center (DAC) 21 Nov 2000.

C. OBJECTIVE. The objective of the testing was to evaluate the 120MM Composite Monopack Pallet, when transportability tested in accordance with TP-94-01, Revision 2, June 2004.

D. CONCLUSION. The 120MM Composite Monopack Pallet is adequate to be transported in an intermodal container.

During the rail impact testing in a boxcar the compression of the Composite Monopack Pallets was excessive and caused the pallets to bow upward and caused damage to one top pallet. There was also excessive movement of the Composite Monopack Pallets during testing. Therefore, the 120MM Composite Monopack Pallet stacked two high **is not adequate** to be transported by rail in a boxcar.

PART 2 - ATTENDEES

ATTENDEE

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PART 3 - TEST EQUIPMENT

1. 120MM Composite Monopack Pallet

Length: 53.5 inches

Width: 44.5 inches

Height: 36.5 inches

2. Truck, Tractor, MTV, M1088 A1

ID #: J0231

NSN: 2320 01 447 3893

VSN: NL1FR5

MFG Serial #: T-018447EFJM

Weight: 19,340 pounds

3. Semitrailer, flatbed, breakbulk/container transporter, 34 ton

Model #: M872A1

Manufactured by Heller Truck Body Corporation, Hillsdale, NJ

ID #: 11-1505 NX05NZ

NSN: 2330 01 109 8006

Weight: 19,240 pounds

PART 4 - TEST PROCEDURES

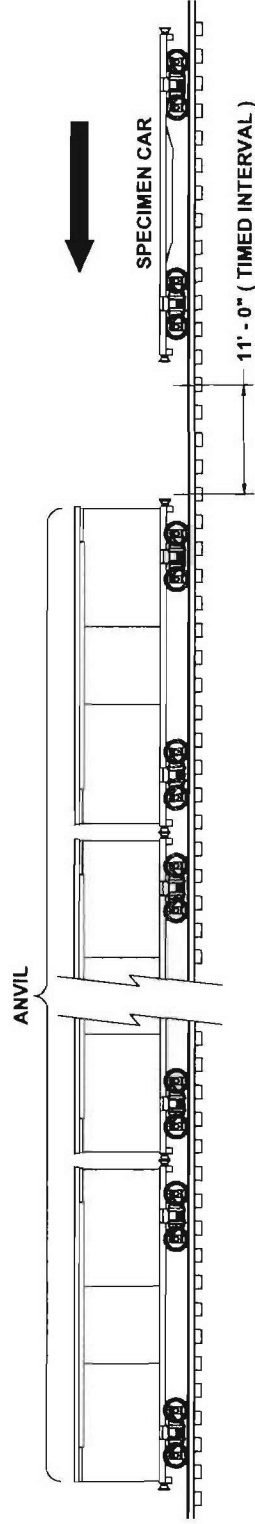
The test procedures outlined in this section were extracted from TP-94-01, "Transportability Testing Procedures," Revision 2, June 2004, for validating tactical vehicles and outloading procedures used for shipping munitions by tactical truck, railcar, and ocean-going vessel.

The rail impact will be conducted with the loaded intermodal container secured directly to the railcar. Inert (non-explosive) items were used to build the load. The test loads were prepared using the blocking and bracing procedures proposed for use with munitions (**see Part 6 for procedures**). The weight and physical characteristics (weights, physical dimensions, center of gravity, etc.) of the test loads were similar to live (explosive) ammunition.

A. RAIL TEST. RAIL IMPACT TEST METHOD. The test load or vehicle will be secured to a flatcar. The equipment needed to perform the test will include the specimen (hammer) car, four empty railroad cars connected together to serve as the anvil, and a railroad locomotive. The anvil cars will be positioned on a level section of track with air and hand brakes set and with draft gears compressed. The locomotive unit will push the specimen car toward the anvil at a predetermined speed, then disconnect from the specimen car approximately 50 yards away from the anvil cars allowing the specimen car to roll freely along the track until it strikes the anvil. This will constitute an impact. Impacting will be accomplished at speeds of 4, 6, and 8.1 mph in one direction and at a speed of 8.1 mph in the reverse direction. The tolerance for the speeds is plus 0.5 mph, minus 0.5 mph for the 4 mph and 6 mph impacts, and plus 0.5 mph, minus 0 mph for the 8.1 mph impacts. The impact speeds will be determined by using an electronic counter to measure the time for the specimen car to traverse an 11-foot distance immediately prior to contact with the anvil cars (see Figure 1).

ASSOCIATION OF AMERICAN RAILROADS (AAR)

STANDARD TEST PLAN



4 BUFFER CARS (ANVIL)

WITH DRAFT GEAR

COMPRESSED AND AIR BRAKES IN A SET
POSITION

ANVIL CAR TOTAL WT. 250,000 LBS (APPROX)

SPECIMEN CAR IS RELEASED BY SWITCH ENGINE
TO

ATTAIN: IMPACT NO. 1 @ 4 MPH

IMPACT NO. 2 @ 6 MPH

IMPACT NO. 3 @ 8.1 MPH

THEN THE CAR IS REVERSED AND RELEASED BY
SWITCH ENGINE TO ATTAIN:

IMPACT NO. 4 @ 8.1 MPH

Figure 1. Rail Impact Sketch

B. ON/OFF ROAD TEST.

1. HAZARD COURSE. The test load or vehicle will be transported over the 200-foot-long segment of concrete-paved road consisting of two series of railroad ties projecting 6 inches above the level of the road surface. The hazard course will be traversed two times (see Figure 2).

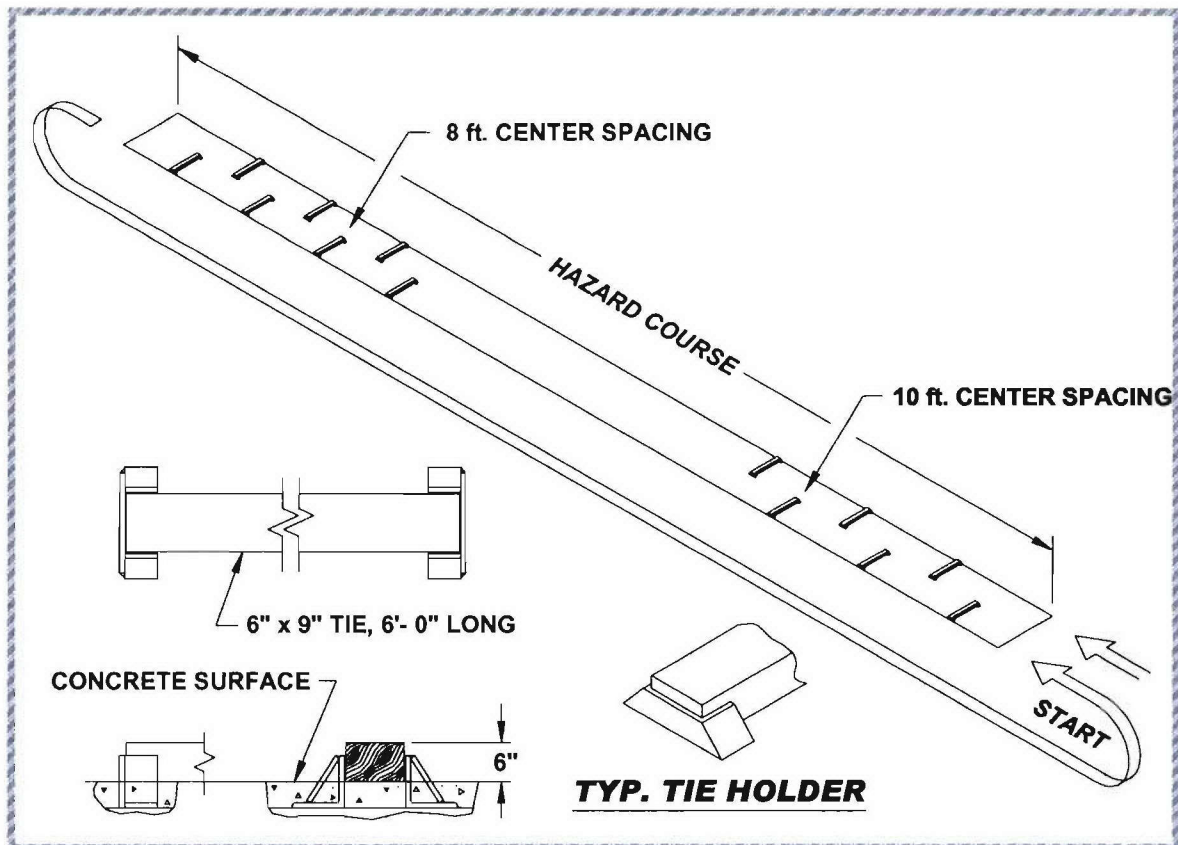


Figure 2. Hazard Course Sketch

- a. The first series of 6 ties are spaced on 10-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.
- b. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.

c. The second series of 7 ties are spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 48 feet.

d. The test load is driven across the hazard course at speeds that will produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

2. ROAD TRIP. The test load or vehicle will be transported for a distance of 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. The test route will include curves, corners, railroad crossings and stops and starts. The test load or vehicle will travel at the maximum speed for the particular road being traversed, except as limited by legal restrictions.

3. PANIC STOPS. During the road trip, the test load or vehicle will be subjected to three (3) full airbrake stops while traveling in the forward direction and one in the reverse direction while traveling down a 7 percent grade. The first three stops are at 5, 10, and 15 mph while the stop in the reverse direction is approximately 5 mph. This testing will not be required if the Rail Impact Test is performed.

4. WASHBOARD COURSE. The test load or vehicle will be driven over the washboard course at a speed that produces the most violent response in the vertical direction.

C. OCEAN-GOING VESSEL TEST. 80-DEGREE TILT TEST. The test load (specimen) shall be positioned on level terrain with the bottom corner fittings resting on timbers so the entire container is supported solely by the bottom corner fittings. The timbers shall be oriented parallel to the end rails of the container and extend 2 feet beyond the corner fittings on each side. Using two mobile cranes and appropriate rigging, the container shall be rotated (tilted) using the bottom corner fittings on one side as a fulcrum. The rigging (slings) of one

crane shall be attached to the bottom corner fittings of the long side and the rigging (slings) of the second crane shall be attached to the top corner fittings on the opposite side. The tilting shall be accomplished by lifting the bottom corner fittings with the first crane so the container rotates about the opposite bottom corner fittings (fulcrum). Lifting/rotating by the first crane is continued until the center of gravity passes over the fulcrum, at which point the second crane shall provide support to the container and lower the container to the 80 degrees, plus or minus 2 degrees position. Rotation shall be accomplished smoothly at a slow speed so the container sidewall is subjected only to the static force of the interior load. The crane booms shall be adjusted to maintain a rear vertical suspension of the rigging at all times. In the case of end-opening type containers, at least one door (lower side of tilted container) must be closed and fastened throughout the test. The container shall be held in the tilted position for a minimum of two minutes. At which time, observations of both the container structure and the interior load shall be made. When the test is completed, the container shall be returned to its upright position using the same manner and care in handling.

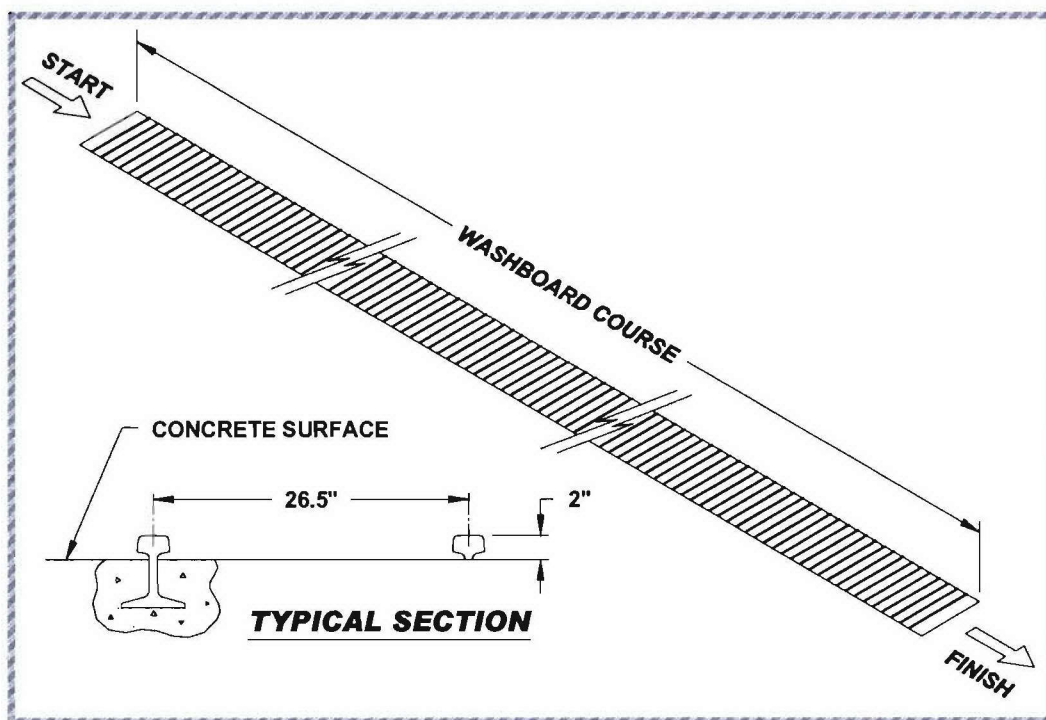


Figure 3. Washboard Course Sketch

PART 5 - TEST RESULTS

5.1 The 120MM Composite Monopack Pallets were inertly loaded to the specified design weight using inert material. The test specimen was prepared using the procedures specified in Part 6- Drawings. Special care was taken to ensure that the inert load had the proper amount of weight in order to achieve a realistic center of gravity (CG). Once properly prepared, four 120MM Composite Monopack Pallets were transportability tested using the TP-94-01 requirements.

Payload: Four (4) 120MM Composite Monopack Pallets in an end-opening intermodal container.

Testing Date: 11-12 July 2005

Gross Weight: 43,360 pounds (including the 120MM Composite Monopack Pallets, ballast payload, and the intermodal container).



Photo 1. 120MM Composite Monopack Pallets in the Intermodal Container

A. RAIL TEST.



**Photo 2. Rail Impact Testing of the 120MM Composite Monopack Pallets
(Prior to Testing)**

Description	Weight
Flatcar Number: DODX 42353	85,000 lbs.
ISTF- APPLS on the Hyundai CROP	24,760 lbs.
End-Opening Intermodal Container with 120MM Composite Monopack Pallets	43,360 lbs.
Total Specimen Wt.	153,120 lbs.
Buffer Car (four cars)	257,900 lbs.

Figure 4.

Remarks: Figure 4 lists the test components and weights of the items used during the Rail Impact Tests.

Impact Number	Avg. Velocity (mph)
1	4.1
2	6.3
3	8.3
4	8.7

Figure 5.

Remarks:

1. Figure 5 lists the average speeds of the specimen car immediately prior to impact with the anvil. Impact #4 is the reverse impact.
2. Following Impact #3 the 120MM Composite Monopack Pallets had moved 1.5-2.0 inches in the direction of impact.
3. Following Impact #4 the 120MM Composite Monopack Pallets had moved 1.5-2.00 inches in the direction of impact.
4. No damage occurred to the 120MM Composite Monopack Pallets.

B. ON/OFF ROAD TESTS.

1. HAZARD COURSE.



**Photo 3. Hazard Course Testing
of the 120MM Composite Monopack Pallets**

Pass No.	Elapsed Time	Avg. Velocity (mph)
1	28 Seconds	5.4
2	26 Seconds	5.9

Figure 6.

Remarks:

1. Figure 6 lists the average speeds of the test load through the Hazard Course.
2. Inspection following each pass did not reveal any damage to the 120MM Composite Monopack Pallets.

2. ROAD TRIP:

Remarks:

1. The Road Trip was conducted between the Road Hazard Course Passes #2 and #3.
2. Inspection following the Road Trip revealed no damage to the 120MM Composite Monopack Pallets.

3. PANIC STOPS: Testing was not required since the load was rail impact tested.

4. HAZARD COURSE:

Pass No.	Elapsed Time	Avg. Velocity (mph)
3	28 Seconds	5.4
4	27 Seconds	5.6

Figure 7.

Remarks:

1. Figure 7 lists the average speeds of the test load through the Hazard Course.

2. Inspection following the Road Trip revealed no damage to the 120MM Composite Monopack Pallets.

5. WASHBOARD COURSE:

Remarks:

1. Inspection following the completion of the Washboard Course revealed no damage to the 120MM Composite Monopack Pallets.

C. CONCLUSION: The 120MM Composite Monopack Pallet is adequate to be transported in an intermodal container.

5.2 The 120MM Composite Monopack Pallets were inertly loaded to the specified design weight using inert material. The test specimen was prepared using the procedures specified in Part 6- Drawings. Special care was taken to ensure that the inert load had the proper amount of weight in order to achieve a realistic center of gravity (CG). Once properly prepared, the six (6) 120MM Composite Monopack Pallets were transportability tested using the TP-94-01 requirements. Two (2) 120MM Composite Pallets were located at one end and four (4) 120MM Composite Monopack Pallets were located at the opposite end of the boxcar as shown in Part 6 – Drawings.

Payload: Six (6) 120MM Composite Monopack Pallets in a boxcar.

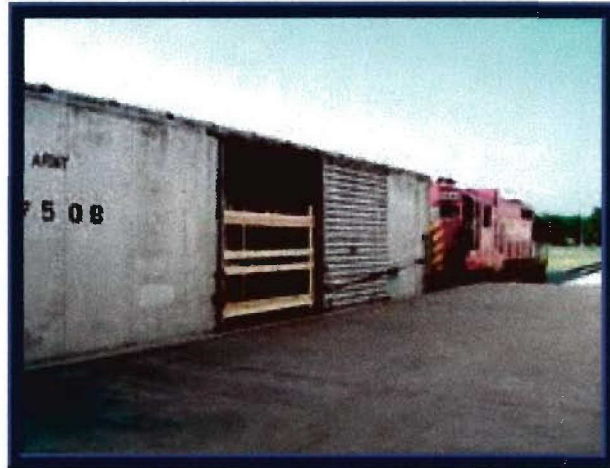
Testing Date: 11 August 2005

Gross Weight: 65,610 pounds (including the 120MM Composite Monopack Pallets and the ballast payload).



Photo 4. 120MM Composite Monopack Pallets in the Boxcar

A. RAIL TEST.



**Photo 5. Rail Impact Testing of the 120MM Composite Monopack Pallets
(Prior to Testing)**

Description	Weight
Boxcar Number: DODX 42353	64,600 lbs.
120MM Composite Monopack Pallets, Ballast Payload and Dunnage	65,610 lbs.
Total Specimen Wt.	130,210 lbs.
Buffer Car (four cars)	258,500 lbs.

Figure 8.

Remarks: Figure 8 lists the test components and weights of the items used during the Rail Impact Tests.

Impact Number	Avg. Velocity (mph)
1	4.3
2	6.5
3	7.9
4	8.3
5	8.4

Figure 9.

Remarks:

1. Figure 9 lists the average speeds of the specimen car immediately prior to impact with the anvil. Impact #5 is the reverse impact.

2. Impact #3 was determined to be a “no test” due to the insufficient velocity at impact. The test was repeated.

3. Following Impact #1 the pallets on the non-impact end moved 1-inch in the direction of impact.

4. Following Impact #2 the top 120MM Composite Monopack Pallet on the non-impact end moved an additional 1.5 inches in the direction of impact. The 120MM Composite Monopack Pallets on the impact end compressed and the Insensitive Munitions (IM) panels on the side deflected out.

5. Following Impact #3 the IM side panel disengaged from the tab and deflected out. The top 120MM Composite Monopack Pallet on the non-impact end moved an additional 2.5 inches in the direction of impact. The bottom 120MM Composite Monopack Pallet on the non-impact end moved an additional 2 inches in the direction of impact.

6. Following Impact #4 the top and bottom 120MM Composite Monopack Pallets on the non-impact end moved an additional 2 inches in the direction of impact. The top 120MM Composite Monopack Pallets on the impact end compressed and bowed in the center.

7. Following Impact #5, on the non-impact end, the top 120MM Composite Monopack Pallet moved 4 inches and the bottom 120MM Composite Monopack

Pallet moved 3.75 inches in the direction of impact. Following the impact there was a gap of 4 inches between the stacks of 120MM Composite Monopack Pallets on the non-impact end. On the impact end the top 120MM Composite Monopack Pallet compressed, bowed and the wooden top assembly cracked.

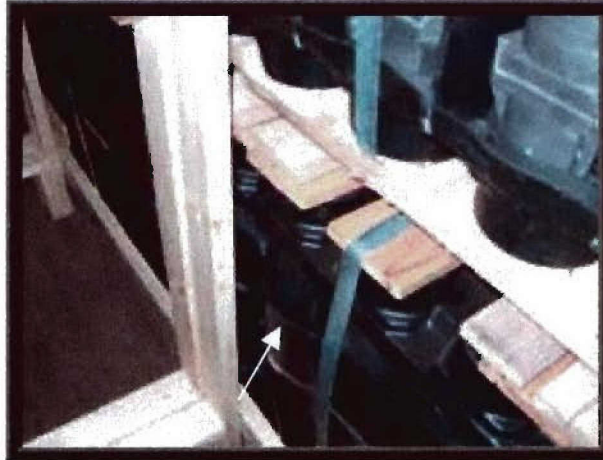


Photo 6. IM Panel Deflection



Photo 7. Bowed Pallet Top Assembly



Photo 8. Movement Between Pallets



Photo 9. Damaged Pallet Top Assembly

C. CONCLUSION: The 120MM Composite Monopack Pallet stacked two high **is not adequate** to be transported by rail in a boxcar. During testing, the compression of the 120MM Composite Monopack Pallets was excessive and caused the pallets to bow upward and caused damage to one top pallet. There was also excessive movement of the 120MM Composite Monopack Pallets during testing.

PART 6 – DRAWINGS

The following drawing represents the load configuration that was subjected to the test criteria.

REVISION NO. 1 APPROVED BY
BUREAU OF EXPLOSIVES

DATE

5/13/94

LOADING AND BRACING WITH WOODEN DUNNAGE IN END OPENING ISO CONTAINERS OF BOXED AMMUNITION AND COMPONENTS ON 4-WAY ENTRY PALLET AND SKID BASES

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- LOADING AND BRACING SPECIFICATIONS SET FORTH WITHIN THIS DRAWING ARE APPLICABLE TO LOADS THAT ARE TO BE SHIPPED BY TRAILER/CONTAINER-ON-FLATCAR (T/COFC) RAIL CARRIER SERVICE. THESE SPECIFICATIONS MAY ALSO BE USED FOR LOADS THAT ARE TO BE MOVED BY MOTOR OR WATER CARRIERS.

U.S. ARMY MATERIEL COMMAND DRAWING

APPROVED, U.S. ARMY ARMAMENT, MUNITIONS AND
CHEMICAL COMMAND

APPROVED BY ORDER OF COMMANDING GENERAL, U.S.
ARMY MATERIEL COMMAND

U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

REVISION NO. 1

JUNE 1994

SEE THE REVISION LISTING ON PAGE 8

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GENERAL NOTES

- A. THIS DOCUMENT HAS BEEN PREPARED AND ISSUED IN ACCORDANCE WITH AR 740-1 AND AUGMENTS TM 743-200-1 (CHAPTER 5).
- B. THE OUTLOADING PROCEDURES SPECIFIED IN THIS DRAWING ARE APPLICABLE TO LOADS OF BOXED AMMUNITION AND COMPONENTS ON 4-WAY ENTRY PALLETS AND SKIDDED BASES. SUBSEQUENT REFERENCE TO A PALLET UNIT OR A SKIDDED UNIT HEREIN MEANS THE UNIT WITH AMMUNITION ITEMS. SEE PAGES 3 THRU 6 AND PAGE 9 FOR "TYPICAL UNIT DETAILS". CAUTION: REGARDLESS OF THE QUANTITY OF UNITS TO BE SHIPPED, THE "MAXIMUM GROSS WEIGHT" OF THE CONTAINER MUST NOT BE EXCEEDED.
- C. THE LOADS AS SHOWN ARE BASED ON 4,700 POUND 20' LONG BY 8' WIDE BY 8'-6" HIGH END OPENING ISO CONTAINER WITH INSIDE DIMENSIONS OF 19'-4" LONG BY 92" WIDE BY 95" HIGH (93" CLEAR HEIGHT) AND A MAXIMUM GROSS WEIGHT OF 52,910 POUNDS. THE LOAD IS DESIGNED FOR TRAILER/CONTAINER-ON-FLATCAR (T/COFC) SHIPMENT, HOWEVER, THE LOAD AS DESIGNED CAN ALSO BE MOVED BY MOTOR OR WATER CARRIERS. NOTICE: OTHER CONTAINERS OF THE SAME DESIGN CONFIGURATION CAN ALSO BE USED.
- D. WHEN LOADING THE UNITS, THEY ARE TO BE POSITIONED SO AS TO ACHIEVE A TIGHT LOAD (TIGHT AGAINST THE DUNNAGE ASSEMBLIES). THE UNBLOCKED SPACE ACROSS THE WIDTH OF A LOAD BAY IS NOT TO EXCEED 1-1/2". EXCESSIVE SLACK CAN BE ELIMINATED FROM A LOAD BY LAMINATING ADDITIONAL PIECES OF APPROPRIATE THICKNESS TO THE SIDE FILL OR CENTER FILL ASSEMBLIES. NAIL EACH ADDITIONAL PIECE TO THE VERTICAL PIECE W/1 APPROPRIATELY SIZED NAIL EVERY 12". ADDITIONALLY, THE THICKNESS AND QUANTITY OF THE DUNNAGE LUMBER USED MAY BE ADJUSTED AS REQUIRED TO FACILITATE VARIANCE IN THE SIZE OF THE LADING UNIT.
- E. DUNNAGE LUMBER SPECIFIED IS OF NOMINAL SIZE. FOR EXAMPLE, 1" X 6" MATERIAL IS ACTUALLY 3/4" THICK BY 5-1/2" WIDE AND 2" X 6" MATERIAL IS ACTUALLY 1-1/2" THICK BY 5-1/2" WIDE. THOSE MEMBERS SPECIFICALLY IDENTIFIED AS "STRUTS" WITHIN THE KEY NUMBERS OF A DEPICTED LOAD ARE SPECIFIED TO BE 4" X 4" MATERIAL, IT IS PERMISSIBLE TO USE TWO LAMINATED PIECES OF 2" X 4" MATERIAL IN LIEU OF EACH 4" X 4" STRUT, DOUBLED 2" X 4" STRUTS WILL BE LAMINATED W/1-10d NAIL EVERY 6".
- F. A STAGGERED NAILING PATTERN WILL BE USED WHENEVER POSSIBLE WHEN NAILS ARE DRIVEN INTO JOINTS OF DUNNAGE ASSEMBLIES OR WHEN LAMINATING DUNNAGE. ADDITIONALLY, THE NAILING PATTERN FOR AN UPPER PIECE OF LAMINATED DUNNAGE WILL BE ADJUSTED AS REQUIRED SO THAT A NAIL FOR THAT PIECE WILL NOT BE DRIVEN THROUGH ONTO OR RIGHT BESIDE A NAIL IN A LOWER PIECE.
- G. IN SOME CONTAINERS, SUCH AS SOME ALL STEEL CONTAINERS, THERE IS A SLOT AT THE CORNERS OF THE FORWARD WALL. A PIECE OF DUNNAGE MATERIAL MUST BE LAMINATED TO THE BUFFER PIECES OF THE FORWARD BLOCKING ASSEMBLY TO PROVIDE A FLAT SURFACE FOR THE 1" X 4" OR 2" X 4" BUFFER PIECES. A PIECE OF 2" X 4", 2" X 3", OR A SPECIAL WIDTH PIECE CUT-TO-FIT CAN BE USED. THIS FILL PIECE WILL BE NAILED WITH ONE APPROPRIATELY SIZED NAIL EVERY 12". THIS PIECE IS NOT REQUIRED WHEN THE FRONT WALL OF THE CONTAINER IS SMOOTH AND FLAT.
- H. CAUTION: DO NOT NAIL DUNNAGE MATERIAL TO THE CONTAINER WALLS OR FLOOR. ALL NAILING WILL BE WITHIN THE DUNNAGE.
- J. PORTIONS OF THE CONTAINER DEPICTED WITHIN THIS DRAWING, SUCH AS ONE OF THE SIDEWALLS, HAVE NOT BEEN SHOWN IN THE LOAD VIEW FOR CLARITY PURPOSES.
- K. TO MAKE LOADING EASIER, TO HELP ACHIEVE A TIGHT LOAD ACROSS A CONTAINER, AND TO PREVENT UNACCEPTABLE DAMAGE TO LADING UNITS WHEN LOADING A CONTAINER, A SLIP-SHEET CAN BE USED EFFECTIVELY AS A "SHOEHORN" TYPE DEVICE. THE SLIP-SHEET WILL PROVIDE A SMOOTH SURFACE THAT WILL PREVENT UNIT STRAPS AND/OR BOXES AND/OR BOX CLEATS FROM INTERLOCKING OR CATCHING ON OTHER PROJECTIONS WHEN LATERALLY ADJACENT LADING UNITS ARE BEING LOADED. A SLIP-SHEET WILL BE USED AFTER ONE-HALF OF A STACK IS LOADED WITH ONE OF ITS SIDES IN TIGHT CONTACT AT ONE SIDE OF THE CONTAINER. THE SLIP-SHEET IS TO BE PLACED AGAINST THE OTHER SIDE OF THE HALF-STACK BEFORE THE HALF OF THE STACK IS LOADED. AFTER A STACK IS COMPLETED, THE SLIP-SHEET IS TO BE REMOVED FOR SUBSEQUENT USE WITH THE NEXT STACK. A SLIP-SHEET OF SUITABLE SIZE CAN BE MADE FROM A SHEET OF 1/8" TEMPERED HARDBOARD (MASONITE) OR FROM A SHEET OF ANY OTHER MATERIAL THAT WILL SATISFY THE REQUIREMENT.

(CONTINUED AT RIGHT)

(GENERAL NOTES CONTINUED)

- L. CONVERSION TO METRIC EQUIVALENTS: DIMENSIONS WITHIN THIS DOCUMENT ARE EXPRESSED IN INCHES AND WEIGHTS ARE EXPRESSED IN POUNDS. WHEN NECESSARY, THE METRIC EQUIVALENTS MAY BE COMPUTED ON THE BASIS OF ONE INCH EQUALS 25.4 MM AND ONE POUND EQUALS 0.454 KG.
- M. REQUIREMENTS CITED WITHIN THE BUREAU OF EXPLOSIVES PAMPHLET 6C APPLY WHEN THE SHIPMENT MOVES BY TRAILER/CONTAINER-ON-FLATCAR (T/COFC). SPECIAL T/COFC NOTES FOLLOW:
1. A LOADED CONTAINER MUST BE ON A CHASSIS EQUIPPED WITH TWO BOGIE ASSEMBLIES WHEN BEING MOVED IN TOFC SERVICE.
 2. THE LOAD LIMIT OF A T/COFC RAILCAR MUST NOT BE EXCEEDED, NOR WILL A CAR BE LOADED SO THAT THE TRUCK UNDER ONE END OF THE CAR CARRIES MORE THAN ONE-HALF OF THE LOAD LIMIT FOR THAT CAR.
- N. DURING INTRASTATE AND/OR INTERSTATE MOVES BY MOTOR CARRIER, A PROPER CHASSIS OR MODIFIED FLATBED TRAILER MUST BE USED TO PRECLUDE VIOLATION OF ONE OR MORE "WEIGHT LAWS" APPLICABLE TO THE STATE OR STATES INVOLVED.
- O. THE QUANTITY OF LADING UNITS SHOWN IN THE LOADS MAY BE REDUCED FOR SHIPMENT, IF DESIRED. SEE THE "TYPICAL REDUCED LOAD" ON PAGE 81. WHEN A CONTAINER IS TO BE LOADED WITH A REDUCED QUANTITY OF LADING UNITS, THE LENGTHWISE CENTER OF GRAVITY OF THE LOAD MUST BE WITHIN 12", IN EITHER DIRECTION, OF THE MID-POINT OF THE CONTAINER.
1. IF A LOAD IS REDUCED BY ONLY A SMALL AMOUNT (ONE OR TWO LADING UNITS), LADING UNITS NORMALLY MAY BE ELIMINATED FROM THE CENTER OF THE LOAD.
 2. IF A LOAD IS REDUCED BY A LARGE AMOUNT (MORE THAN TWO LADING UNITS), LADING UNITS SHOULD BE ELIMINATED AS REQUIRED AND THE TOTAL LOAD SHIFTED FORE OR AFT, AS NECESSARY, TO ACHIEVE A SYMMETRICAL WEIGHT DISTRIBUTION. THE DEPICTED PROCEDURES WILL BE FOLLOWED AS CLOSELY AS POSSIBLE, MAKING ONLY THOSE ADJUSTMENTS TO THE DUNNAGE WHICH ARE REQUIRED TO ACCOMMODATE THE NUMBER OF UNITS TO BE SHIPPED.
- P. FILL MATERIAL HEIGHT MUST BE EITHER INSIDE CONTAINER HEIGHT MINUS 1" (REF: 7'-10") OR THE HEIGHT OF THE TOP BOX BEAM OR BEAM ASSEMBLY IN THE REAR BLOCKING ASSEMBLY PLUS 6", WHICHEVER IS LESS.
- Q. TWO TOP SPACER ASSEMBLIES ARE REQUIRED WHENEVER THE LENGTH OR WIDTH DIMENSION OF THE LADING UNITS TO BE BRACED, PARALLEL TO THE CONTAINER WALL, EXCEEDS 48". TWO TOP SPACERS ARE ALSO REQUIRED IF THE LADING UNIT TO BE BRACED IS NOT SECURED WITH STRAPPING IN THE DIRECTION WHICH IS PARALLEL TO THE CONTAINER SIDEWALL.

(CONTINUED ON PAGE 3)

MATERIAL SPECIFICATIONS

- LUMBER - - - - - : SEE TM 743-200-1 (DUNNAGE LUMBER) AND FED SPEC MM-L-751.
- NAILS - - - - - : FED SPEC FF-N-105; COMMON.
- PLYWOOD - - - - - : COMMERCIAL ITEM DESCRIPTION A-A-55057, TYPE A, CONSTRUCTION AND INDUSTRIAL PLYWOOD, INTERIOR WITH EXTERIOR GLUE, GRADE C-0. IF SPECIFIED GRADE IS NOT AVAILABLE, A BETTER INTERIOR OR AN EXTERIOR GRADE MAY BE SUBSTITUTED.
- STRAPPING, STEEL - - : ASTM D3953; FLAT STRAPPING, TYPE I, HEAVY DUTY, FINISH A, B (GRADE 2), OR C.
- SEAL, STRAP - - - - : ASTM D3953; CLASS H, FINISH A, B (GRADE 2), OR C, DOUBLE NOTCH TYPE, STYLE I, II, OR IV.
- WIRE, CARBON STEEL - - : ASTM A853; ANNEALED AT FINISH, BLACK OXIDE FINISH, .0800" DIA, GRADE 1006 OR BETTER.
- FIBERBOARD - - - - - : FED SPEC PPP-F-320; TYPE SF (SOLID FIBERBOARD), CLASS DOMESTIC, ALL GRADES.

(GENERAL NOTES CONTINUED FROM PAGE 2)

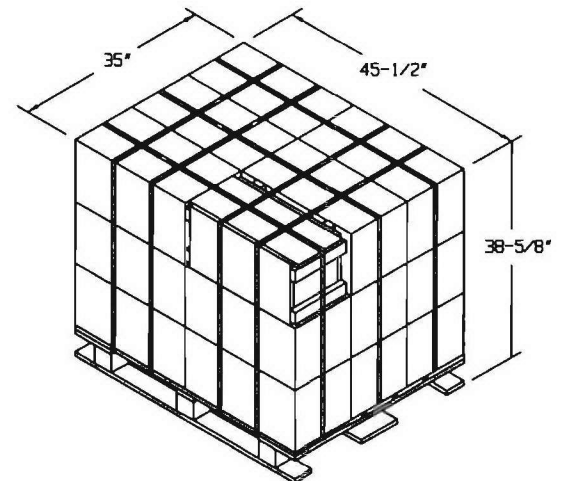
R. WHEN STEEL STRAPPING IS SEALED AT AN END-OVER-END LAP JOINT, A MINIMUM OF ONE SEAL WITH TWO PAIR OF NOTCHES WILL BE USED TO SEAL THE JOINT WHEN A NOTCH-TYPE SEALER IS BEING USED. A MINIMUM OF TWO SEALS, BUTTED TOGETHER WITH TWO PAIR OF CRIMPS PER SEAL WILL BE USED TO SEAL THE JOINT WHEN A CRIMP-TYPE SEALER IS BEING USED. REFER TO THE "STRAP JOINT A" AND "STRAP JOINT B" DETAILS ON PAGE 8 FOR GUIDANCE.

S. MAXIMUM LOAD WEIGHT CRITERIA:

THE MAXIMUM LOAD WEIGHTS ARE CONTROLLED BY EQUIPMENT CAPABILITY FACTORS. ALTHOUGH THE HEAVIEST MAXIMUM LOADS ARE DELINEATED IN THE LOAD VIEWS, PROVISIONS ARE INCLUDED WITHIN THIS DRAWING SO THAT THE BASIC LOADS CAN BE ADJUSTED TO SATISFY A LESSER QUANTITY OF LADING UNITS. DEPENDING ON TRANSPORTATION ROUTING, IT MAY BE NECESSARY TO REDUCE THE LOAD WEIGHT TO SATISFY "WEIGHT LAWS" OF CERTAIN STATES. ALSO, IT MAY BE NECESSARY TO REDUCE THE LOAD WEIGHT TO SATISFY OTHER WEIGHT RESTRICTIONS IMPOSED ON THE INTERMODAL CONTAINER SYSTEM.

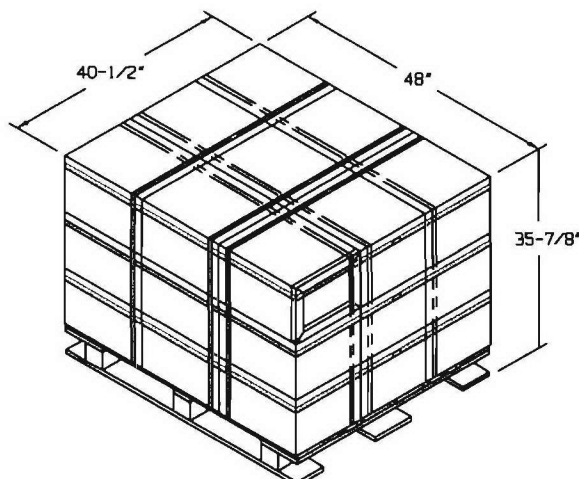
T. THE 4" X 4" STRUTS DEPICTED IN LOADS WITHIN THIS DRAWING ARE CAPABLE OF SUPPORTING 3,000 POUNDS EACH. FOR EXAMPLE, IF A LOAD OF EIGHT PALLET UNITS IS STRUTTED AT THE REAR OF THE CONTAINER, AND EACH PALLET UNIT WEIGHS 3,000 POUNDS, EIGHT STRUTS ARE REQUIRED, 24,000 POUNDS, DIVIDED BY 3,000 EQUATES TO EIGHT STRUTS. DOUBLED 2" X 4" STRUTS WILL SUPPORT 2,500 POUNDS EACH. THE QUANTITY OF STRUTS REQUIRED IS NOT SOLELY DETERMINED BY THE WEIGHT OF THE LOAD. THE LADING UNITS MUST BE FULLY SUPPORTED AND BLOCKED ONLY AGAINST SECTIONS THAT ARE STRONG ENOUGH TO SUPPORT THE FULL LOAD, FOR EXAMPLE, DO NOT BLOCK AGAINST THE MIDDLE OF A WIREBOUND BOX.

U. LOAD-BLOCKING STRUTS WHICH ARE 48" OR LONGER MUST BE STIFFENED BY THE APPLICATION OF HORIZONTAL AND VERTICAL STRUT BRACING AS SHOWN IN THE "STRUT BRACING DETAIL" ON PAGE 73. BRACING IS NOT REQUIRED IF THE STRUTS FOR THE LOAD BEING SHIPPED ARE SHORTER THAN 48". THE LENGTH OF THE LOAD-BLOCKING STRUTS SHOULD BE KEPT AS SHORT AS POSSIBLE (APPROX 12" MINIMUM), BUT IN THE EVENT IT IS NECESSARY TO USE STRUTS WHICH ARE 8'-0" OR MORE IN LENGTH, IT WILL BE NECESSARY TO APPLY AN ADDITIONAL SET OF HORIZONTAL AND VERTICAL STRUT BRACING PIECES. STRUT BRACING SHOULD BE APPLIED SO AS TO PROVIDE NEARLY EQUAL SPACES BETWEEN THE BRACING PIECES AND THE DUNNAGE ASSEMBLIES AND/OR BETWEEN ADJACENT STRUT BRACING PIECES. NOTE THAT HORIZONTAL STRUT BRACING PIECES FOR THE UPPER LEVEL OF STRUTS FOR ALL BUT THE UPPERMOST TIER OF A LOAD MAY BE DIFFICULT TO APPLY TO THE TOP SURFACES OF THE STRUT AS DEPICTED. STRUT BRACING WILL BE EQUALLY EFFECTIVE IF APPLIED TO THE UNDER SIDE OF THOSE STRUTS.



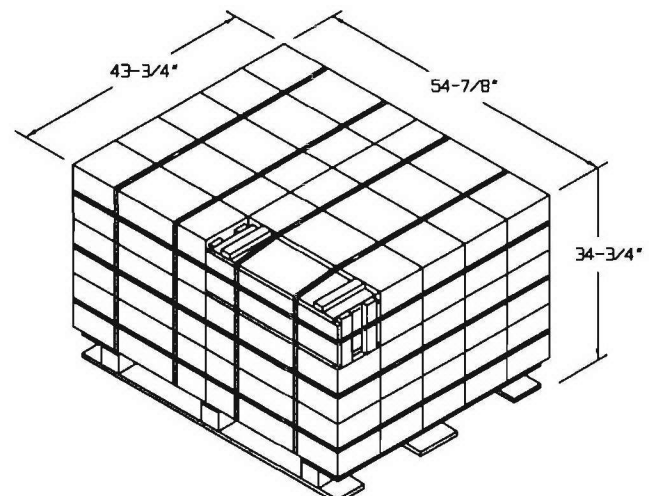
PALLET UNIT NO. 2

UNIT WEIGHT - - - - - 1,224 POUNDS (APPROX)
CUBE - - - - - 35.6 CUBIC FEET



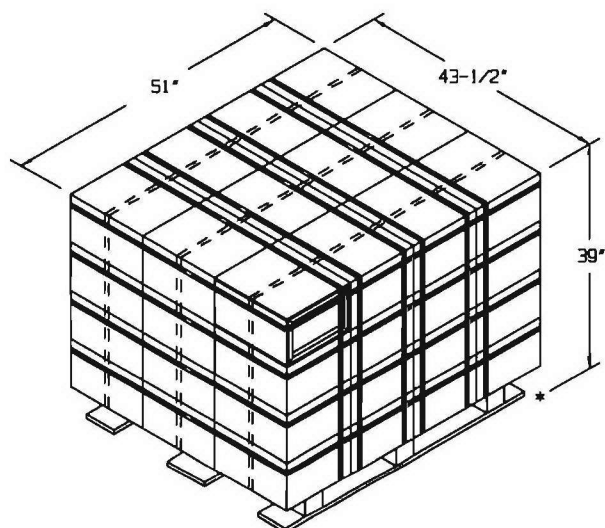
PALLET UNIT NO. 1

UNIT WEIGHT - - - - - 1,518 POUNDS (APPROX)
CUBE - - - - - 40.4 CUBIC FEET



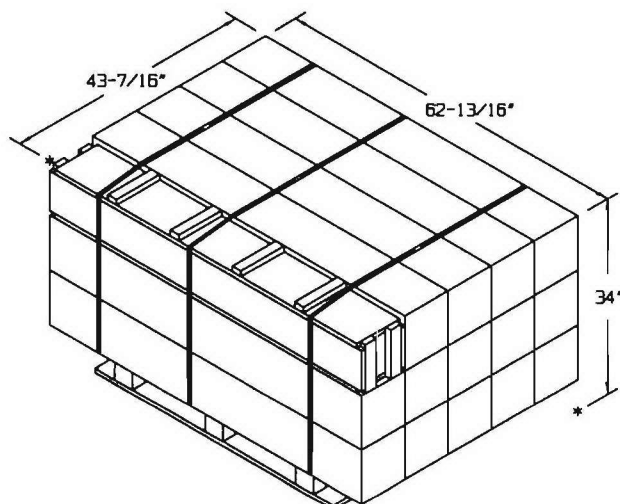
PALLET UNIT NO. 3

UNIT WEIGHT - - - - - 1,868 POUNDS (APPROX)
CUBE - - - - - 48.3 CUBIC FEET



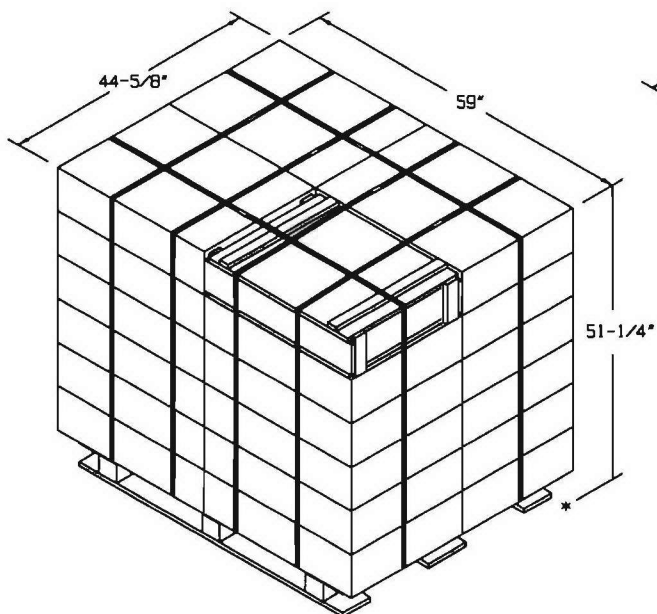
PALLET UNIT NO. 4

UNIT WEIGHT - - - - - 2,729 POUNDS (APPROX)
CUBE - - - - - 50.1 CUBIC FEET



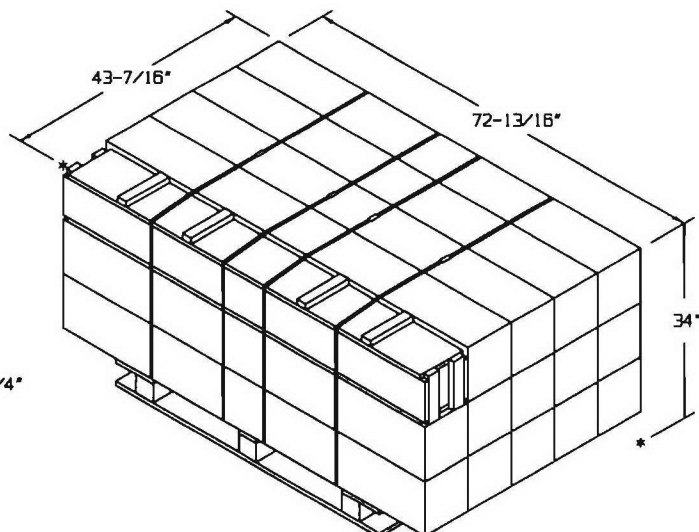
PALLET UNIT NO. 5

UNIT WEIGHT - - - - - 1,988 POUNDS (APPROX)
CUBE - - - - - 53.7 CUBIC FEET



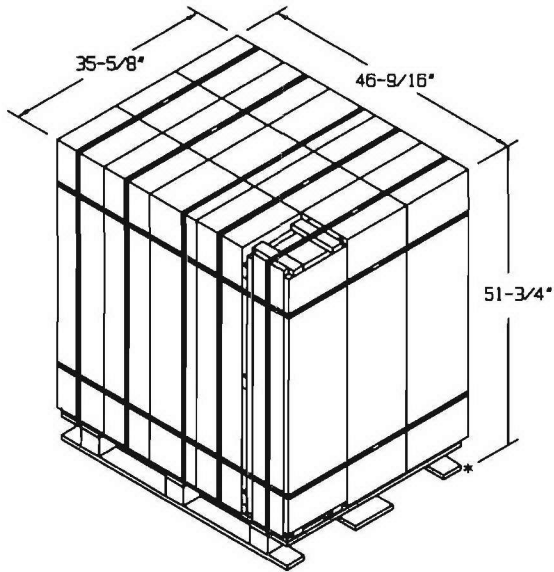
PALLET UNIT NO. 6

UNIT WEIGHT - - - - - 2,330 POUNDS (APPROX)
CUBE - - - - - 78.1 CUBIC FEET



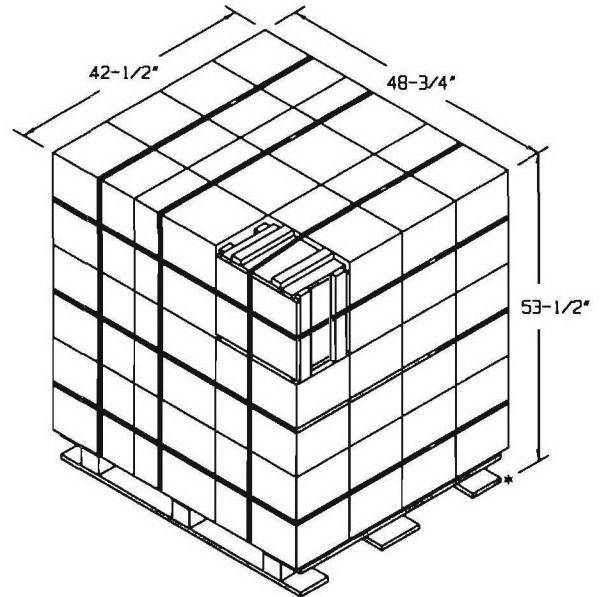
PALLET UNIT NO. 7

UNIT WEIGHT - - - - - 2,524 POUNDS (APPROX)
CUBE - - - - - 62.2 CUBIC FEET



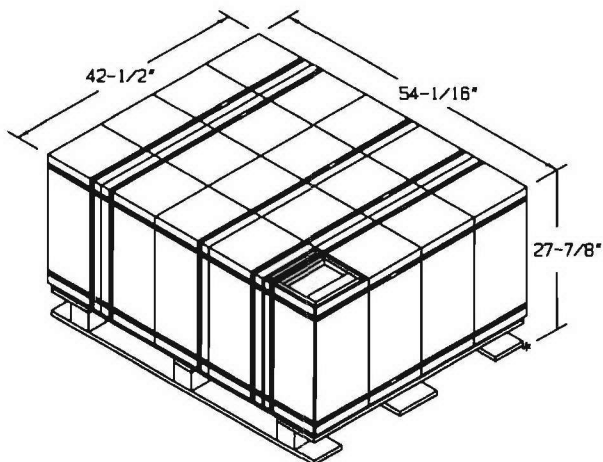
PALLET UNIT NO. 8

UNIT WEIGHT - - - - - 2,188 POUNDS (APPROX)
CUBE - - - - - 49.7 CUBIC FEET



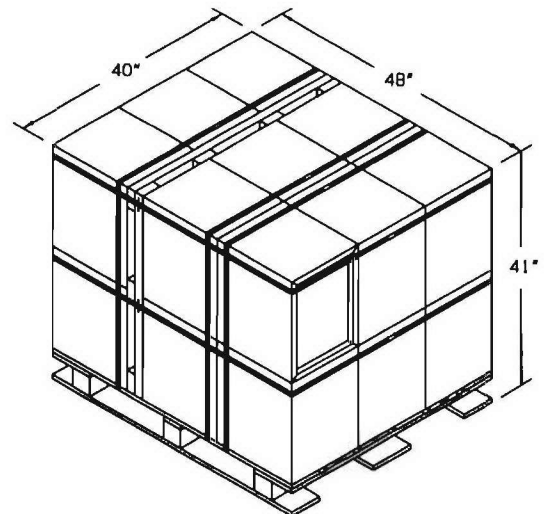
PALLET UNIT NO. 9

UNIT WEIGHT - - - - - 2,679 POUNDS (APPROX)
CUBE - - - - - 64.2 CUBIC FEET



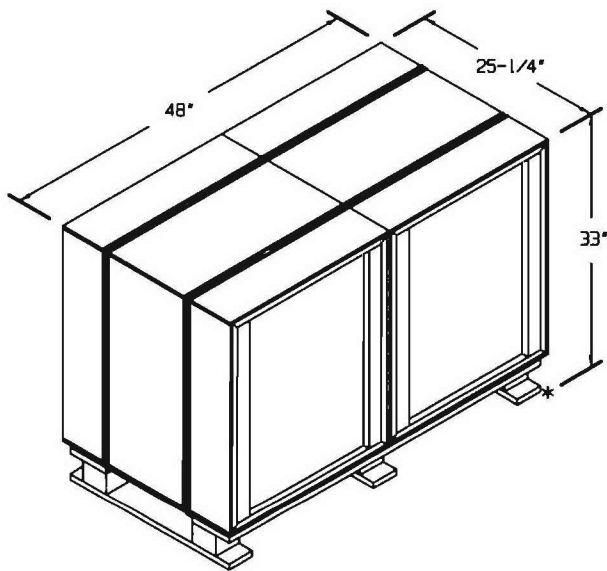
PALLET UNIT NO. 10

UNIT WEIGHT - - - - - 1,377 POUNDS (APPROX)
CUBE - - - - - 37.1 CUBIC FEET



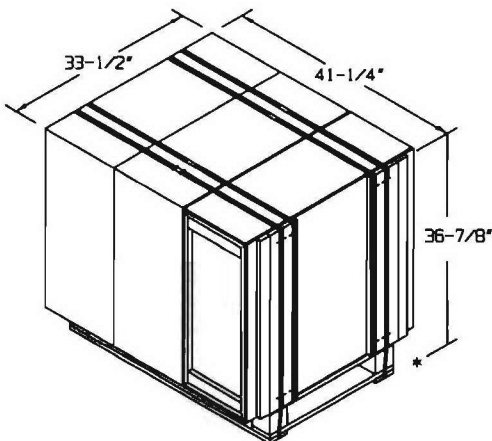
PALLET UNIT NO. 11

UNIT WEIGHT - - - - - 2,051 POUNDS (APPROX)
CUBE - - - - - 45.6 CUBIC FEET



SKIDDED UNIT NO. 1

UNIT WEIGHT - - - - - 294 POUNDS (APPROX)
CUBE - - - - - 23.1 CUBIC FEET



SKIDDED UNIT NO. 2

UNIT WEIGHT - - - - - 480 POUNDS (APPROX)
CUBE - - - - - 29.5 CUBIC FEET

SPECIAL NOTES:

1. THE FOLLOWING SPECIAL NOTES AND THE FIVE CHARTS ON PAGE 7 ARE PRESENTED AS GUIDANCE IN THE SELECTION OF A LOAD PATTERN, AND IN DETERMINING THE QUANTITY OF UNITS WHICH CAN BE LOADED IN A 20' LONG BY 8' WIDE BY 8'-6" HIGH END OPENING ISO CONTAINER, BASED ON THE SIZE AND WEIGHT OF THE PALLETIZED OR SKIDDED UNIT TO BE LOADED.
2. CHART NO. 1 MAY BE USED IN SELECTING A LOAD PATTERN FOR THE WIDTH OF THE CONTAINER WHICH IS TO BE LOADED. THE LOAD PATTERN WILL BE BASED EITHER ON THE UNIT LENGTH ACROSS THE CONTAINER OR ON THE UNIT WIDTH ACROSS THE CONTAINER, DEPENDENT UPON THE LENGTH OR WIDTH DIMENSIONS OF THE UNIT TO BE LOADED. UNIT SIZE RANGES AND LOAD PATTERNS FOR A 92" INSIDE WIDTH CONTAINER ARE GIVEN. CONTAINERS OF OTHER WIDTHS MAY BE USED, HOWEVER, THE SIZE RANGE OF THE UNITS WHICH CAN BE LOADED IN THE TWO LOAD PATTERNS WILL HAVE TO BE CALCULATED. THE SMALLER FIGURE SHOWN FOR UNIT SIZE RANGE IS BASED ON THE MINIMUM UNIT LENGTH OR WIDTH, AS APPLICABLE, AND THE LARGER FIGURE IS CALCULATED ON THERE BEING AT LEAST 1" EXCESS LATERAL SPACE REMAINING IN THE CONTAINER AFTER THE UNITS ARE POSITIONED.
3. CHART NO. 2 MAY BE USED IN DETERMINING THE QUANTITY OF UNITS WHICH CAN BE POSITIONED WITHIN ONE ROW IN THE LENGTH OF THE CONTAINER. THE UNIT SIZE RANGE FOR A 20' CONTAINER IS BASED ON THE INSIDE LENGTH OF THE CONTAINER BEING 19'-4" LONG AND ALSO ON A REQUIRED TOTAL INSIDE BLOCKING THICKNESS AVERAGING BETWEEN 14-1/2" AND 25".
4. CHART NO. 3 MAY BE USED IN DETERMINING THE NUMBER OF TIERS WHICH CAN BE LOADED IN A CONTAINER, BASED ONLY UPON THE HEIGHT OF THE UNIT. THE INSIDE HEIGHT OF AN 8'-6" CONTAINER IS 93". THE HEIGHT RANGE OF THE UNITS SPECIFIED ALLOWS AT LEAST 1/2" CLEARANCE AT THE ROOF. NO ALLOWANCE HAS BEEN MADE FOR DOOR OPENING HEIGHT CLEARANCE. FOR LOADS WHICH ARE OF SUCH A HEIGHT AS TO EXTEND TO WITHIN 3" OR 4" OF THE ROOF, IT MAY NOT BE POSSIBLE TO PLACE THE TOP UNITS IN THE REARMOST LOAD BAY. SEE THE "TYPICAL REDUCED LOAD" ON PAGE 81 FOR GUIDANCE. THE ACTUAL NUMBER OF TIERS WHICH CAN BE LOADED WILL BE BASED ON SEVERAL FACTORS SUCH AS THE WEIGHT OF THE UNITS AND THE QUANTITY THAT IS TO BE SHIPPED.
5. CHART NO. 4 MAY BE USED AS GUIDANCE IN DETERMINING THE QUANTITY OF UNITS WHICH CAN BE LOADED IN A CONTAINER, BASED ONLY UPON THE WEIGHT OF THE UNIT. THE "UNIT WEIGHT IN LBS" COLUMN SPECIFIES WEIGHTS RANGING FROM 250 POUNDS, THE APPROXIMATE MINIMUM, TO 4,000 POUNDS, THE MAXIMUM WEIGHT ALLOWABLE IN A PALLET UNIT. THE QUANTITY REQUIRED TO MAKE A SPECIFIED LOAD WEIGHT FOR A UNIT WHICH WEIGHS SOMEWHERE BETWEEN THE FIGURES GIVEN WILL HAVE TO BE CALCULATED BASED ON THE MAXIMUM LOADING WEIGHT RESTRICTION FOR THE CONTAINER TO BE LOADED. FOR EXAMPLE, A TOTAL LOAD OF 22 PALLETIZED OR SKIDDED UNITS WEIGHING 2,000 POUNDS EACH CAN BE LOADED IN A CONTAINER WITHOUT EXCEEDING A 52,910 POUND CONTAINER GROSS WEIGHT LIMITATION.
6. CHART NO. 5 MAY BE USED AS GUIDANCE IN DETERMINING THE NUMBER AND CONFIGURATION OF THE BOX BEAM ASSEMBLIES REQUIRED TO FABRICATE THE FORWARD/REAR BLOCKING ASSEMBLIES FOR A SPECIFIED CONTAINER LOAD WEIGHT. THE BOX BEAM ASSEMBLIES WILL BE ARRANGED IN SUCH A MANNER SO AS TO PROVIDE MAXIMUM SUPPORT FOR EACH TIER BEING BLOCKED. ADDITIONALLY, THE BEAM ASSEMBLIES WILL BE ARRANGED IN A SYMMETRICAL PATTERN FOR EACH TIER. A MINIMUM OF TWO BOX BEAM ASSEMBLIES ARE REQUIRED PER TIER OF LADING, UNLESS THE PALLETIZED OR SKIDDED UNIT BEING LOADED IS CONFIGURED AS A TWO OR ONE BOX HIGH UNIT, IN WHICH CASE ONE BOX BEAM MAY BE USED PER TIER OF LADING, PROVIDING EACH LAYER OF BOXES IS IN CONTACT WITH A BOX BEAM.
7. CHART NO. 6 MAY BE USED AS GUIDANCE IN DETERMINING THE COMBINATIONS OF LENGTHS AND WIDTHS WHICH ARE ACCEPTABLE FOR CHIMNEY-PATTERN LOADS.
8. WHENEVER THE GROSS WEIGHT OF THE LADING BEING LOADED IN A CONTAINER EXCEEDS 28,000 POUNDS AND THE TOTAL HEIGHT OF THE LOAD IS LESS THAN 70", ADDITIONAL SIDEWALL STRENGTHENING MUST BE PROVIDED. THIS ADDITIONAL SIDEWALL STRENGTHENING IS USUALLY PROVIDED IN THE FORM SIDE FILL ASSEMBLIES. FOR ADDITIONAL GUIDANCE, SEE THE SIDE FILL ASSEMBLIES ON PAGES 22, 31, 34, 38, 42, 51, 58, 62 AND 70. WHENEVER THE GROSS WEIGHT OF THE LADING IS LESS THAN 28,000 POUNDS, OR WHEN THE HEIGHT OF THE LADING IS AT LEAST 70", AND THERE IS MORE THAN 1-1/2" OF UNBLOCKED SPACE ACROSS THE WIDTH OF THE LOAD BAY, THIS UNBLOCKED SPACE MUST BE FILLED OUT EITHER BY PLACING SIDE FILL ASSEMBLIES AT THE SIDES OF THE LOAD OR ANTI-SWAY BRACING OR CENTER FILL ASSEMBLIES IN THE CENTER OF THE LOAD. FOR ADDITIONAL GUIDANCE, SEE THE ANTI-SWAY BRACING ASSEMBLIES ON PAGES 72 AND 73 AND THE CENTER FILL ASSEMBLIES ON PAGE 18, 26 AND 46. WHENEVER THE GROSS WEIGHT OF THE LADING IS LESS THAN 28,000 POUNDS OR THE LOAD IS AT LEAST 70" TALL, AND THE UNBLOCKED SPACE ACROSS THE WIDTH OF THE LOAD BAY IS 1-1/2" OR LESS, NEITHER SIDE BLOCKING NOR CENTER BLOCKING WILL BE REQUIRED.

CHART NO. 1				
UNITS IN WIDTH OF 92" INSIDE WIDTH CONTAINER				
LOAD PATTERN	UNIT SIZE RANGE			
	PALLETIZED OR SKIDDED UNITS (LENGTH ACROSS CONTAINER)		PALLETIZED OR SKIDDED UNITS (WIDTH ACROSS CONTAINER)	
	UNIT LENGTH	LOAD PAGE	UNIT WIDTH	LOAD PAGE
2-WIDE	25" - 45-1/2"	10, 16, 20, 24, 28, 32, 40, 44, 56	27" - 45-1/2"	14
3-WIDE	25" - 30-1/2"	—	27" - 30-1/2"	52

CHART NO. 3	
TIERS IN HEIGHT OF 93" INSIDE HEIGHT CONTAINER	
NUMBER OF TIERS	UNIT HEIGHT RANGE
3	23-1/4" - 30-3/4"
2	31" - 46-1/4"
1	OVER 46-1/4"

CHART NO. 2	
UNITS IN LENGTH OF 232" INSIDE LENGTH CONTAINER	
NUMBER OF UNITS LONG	UNIT SIZE RANGE
8	25" - 27"
7	27-1/4" - 31"
6	31-1/4" - 36-1/4"
5	36-1/2" - 43-1/2"
4	43-3/4" - 54-1/4"
3	54-1/2" - 72-1/2"

NOTE ▲:

A BOX BEAM ASSEMBLY CONSISTS OF TWO PIECES OF PLYWOOD AND TWO OR THREE PIECES OF NOMINAL LUMBER. EACH FORWARD/REAR BLOCKING ASSEMBLY CONSISTS OF TWO BUFFER PIECES NAILED TO THE QUANTITY OF BOX BEAM ASSEMBLIES OUTLINED IN "CHART 5" BELOW. SEE ALSO THE "ALTERNATIVE FORWARD/REAR BLOCKING ASSEMBLY" ON PAGE 80. THE BOX BEAM CONFIGURATIONS IN "CHART 5" ARE AS FOLLOWS:

- CONFIGURATION A - TWO 2" X 4" BEAMS AND 1/2" X 9-1/2" PLYWOOD. SEE "FORWARD/REAR BLOCKING ASSEMBLY A" ON PAGE 13 FOR AN EXAMPLE.
- CONFIGURATION B - TWO 2" X 4" BEAMS AND 3/4" X 9-1/2" PLYWOOD. SEE "FORWARD/REAR BLOCKING ASSEMBLY C" ON PAGE 19 FOR AN EXAMPLE.
- CONFIGURATION C - TWO 2" X 6" BEAMS AND 1/2" X 9-1/2" PLYWOOD. SEE "FORWARD/REAR BLOCKING ASSEMBLY F" ON PAGE 30 FOR AN EXAMPLE.
- CONFIGURATION D - TWO 2" X 6" BEAMS AND 3/4" X 9-1/2" PLYWOOD. CONSTRUCT SIMILAR TO CONFIGURATION C, EXCEPT USE 3/4" PLYWOOD.
- CONFIGURATION E - THREE 2" X 4" BEAMS AND 1/2" X 11-1/2" PLYWOOD. CONSTRUCT SIMILAR TO CONFIGURATION F, EXCEPT USE 1/2" PLYWOOD.
- CONFIGURATION F - THREE 2" X 4" BEAMS AND 3/4" X 11-1/2" PLYWOOD. SEE "FORWARD/REAR BLOCKING ASSEMBLY H" ON PAGE 39 FOR AN EXAMPLE.
- CONFIGURATION G - THREE 2" X 6" BEAMS AND 1/2" X 11-1/2" PLYWOOD. CONSTRUCT SIMILAR TO CONFIGURATION E, EXCEPT USE 2" X 6" LUMBER.
- CONFIGURATION H - THREE 2" X 6" BEAMS AND 3/4" X 11-1/2" PLYWOOD. CONSTRUCT SIMILAR TO CONFIGURATION F, EXCEPT USE 2" X 6" LUMBER.

CHART NO. 5								
REQUIRED BOX BEAM ASSEMBLIES FOR FORWARD/REAR BLOCKING ASSEMBLY								
CONFIGURATION OF BOX BEAM ASSEMBLY (SEE NOTE ▲ ABOVE)	MAXIMUM LOAD WEIGHT IN POUNDS							
	NO. OF BOX BEAM ASSEMBLIES PER FORWARD/REAR BLOCKING ASSEMBLY							
	1	2	3	4	5	6	7	8
A	6,325	12,650	18,975	25,300	31,625	37,950	44,275	50,600
B	8,815	17,630	26,445	35,260	44,075	52,890		
C	11,400	22,800	34,200	45,600	57,000			
D	15,085	30,170	45,255	60,340				
E	8,060	16,120	24,180	32,240	40,300	48,360	56,420	
F	11,030	22,060	33,090	44,120	55,150			
G	14,875	29,750	44,625	59,500				
H	19,260	38,520	57,780					

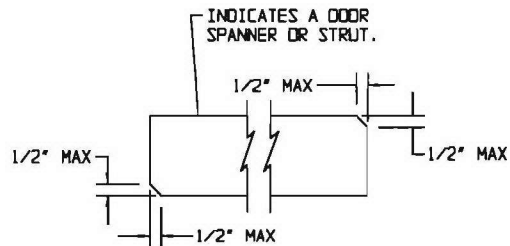
CHART NO. 4	
MAXIMUM NUMBER OF UNITS PER CONTAINER BY WEIGHT	
NO. OF UNITS (52,910 LB LADING LIMIT)	UNIT WEIGHT IN LBS
184	250
153	300
115	400
92	500
76	600
65	700
57	800
51	900
46	1,000
41	1,100
38	1,200
35	1,300
32	1,400
30	1,500
28	1,600
27	1,700
25	1,800
24	1,900
23	2,000
21	2,100
20	2,200
19	2,400
18	2,500
17	2,600
16	2,800
15	2,900
14	3,100
13	3,300
12	3,600
11	3,900
10	4,200

CHART NO. 6	
CONTAINER WIDTH 92" (INSIDE DIMENSION)	
UNIT LENGTH OR WIDTH	PALLETIZED OR SKIDDED UNIT LENGTH/WIDTH COMBINATIONS MINIMUM TO MAXIMUM UNIT WIDTH
45"	36" - 46"
44"	37" - 47"
43"	38" - 48"
42"	39" - 49"
41"	40" - 50"
40"	41" - 51"
39"	42" - 52"
38"	43" - 53"
37"	44" - 54"
36"	45" - 55"
35"	46" - 56"
34"	47" - 57"
33"	48" - 58"
32"	49" - 59"
31"	50" - 60"
30"	51" - 61"
29"	52" - 62"
28"	53" - 63"
27"	54" - 64"

REVISION

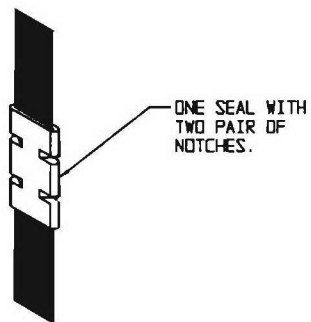
REVISION NO. 1, DATED JUNE 1994, CONSIST OF:

UPDATING DRAWING FORMAT AND STREAMLINING
DUNNAGING METHODS.



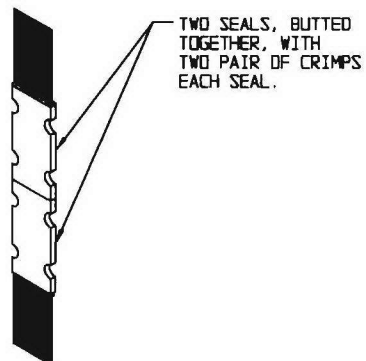
BEVEL-CUT

IF DESIRED, EACH END OF A DOOR SPANNER
PIECE OR STRUT MAY BE BEVEL-CUT AS SHOWN
ABOVE TO FACILITATE THE ACHIEVEMENT OF A
TIGHT DOOR-POST-TO-DOOR-POST OR REAR-OF-
LOAD FIT.



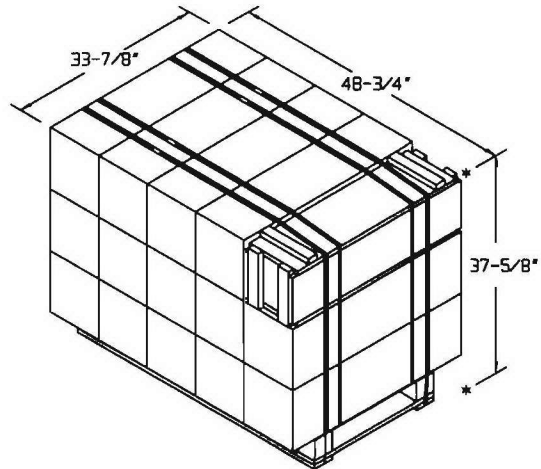
STRAP JOINT A

METHOD OF SECURING A
STRAP JOINT WHEN USING
A NOTCH-TYPE SEALER.



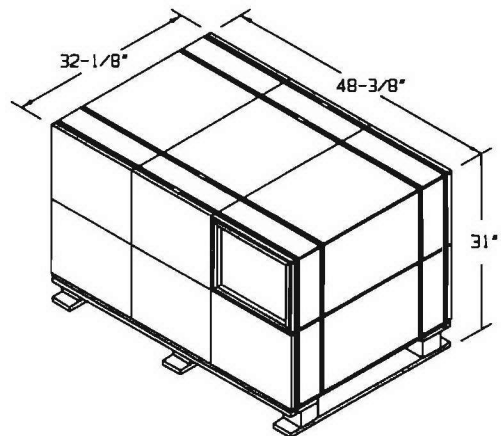
STRAP JOINT B

METHOD OF SECURING A
STRAP JOINT WHEN USING
A CRIMP-TYPE SEALER.



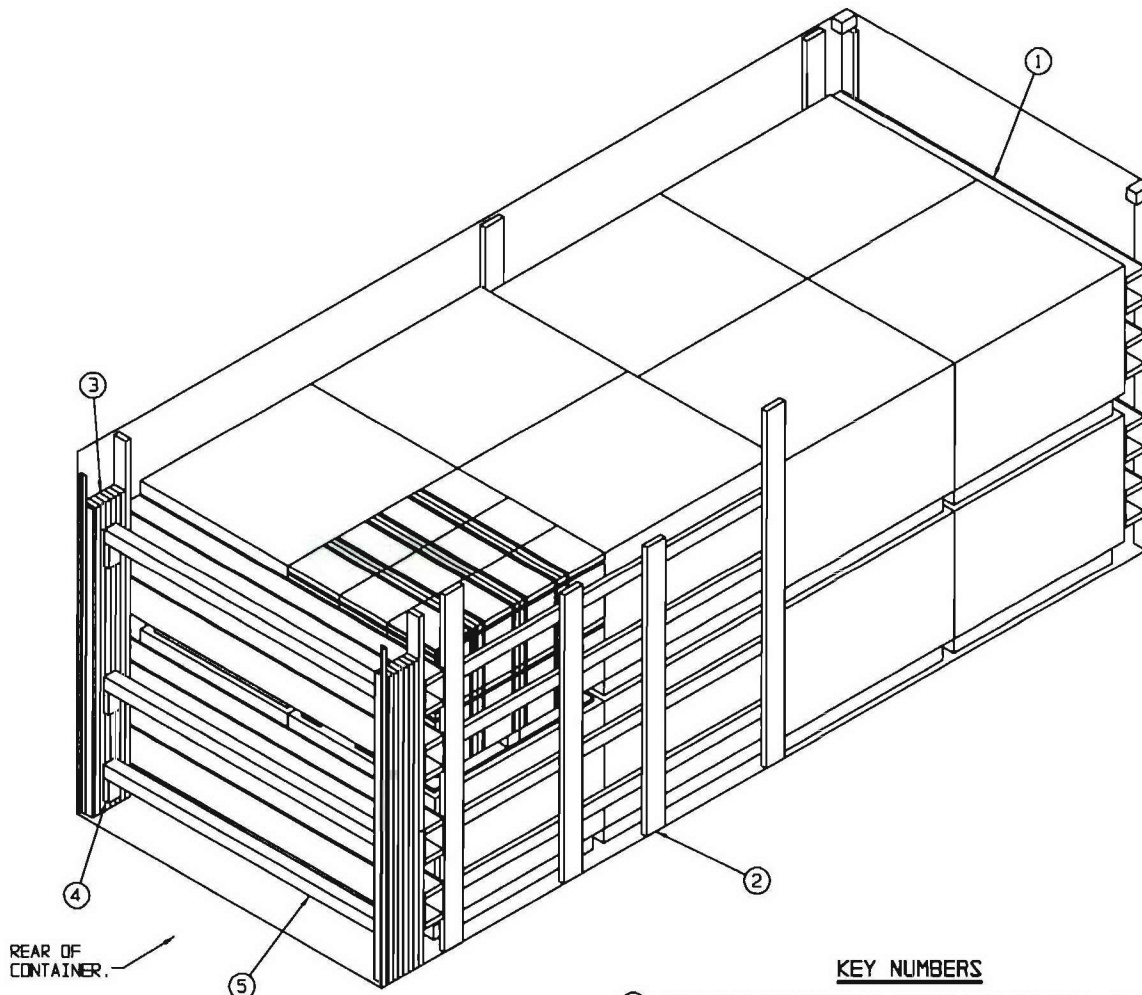
SKIDDED UNIT NO. 3

UNIT WEIGHT - - - - - 1,037 POUNDS (APPROX)
 CUBE - - - - - 36.0 CUBIC FEET



SKIDDED UNIT NO. 4

UNIT WEIGHT - - - - - 790 POUNDS (APPROX)
 CUBE - - - - - 27.9 CUBIC FEET



ISOMETRIC VIEW

KEY NUMBERS

- ① FORWARD/REAR BLOCKING ASSEMBLY D (2 REQD). SEE THE DETAIL ON PAGE 23 AND THE "ALTERNATIVE FORWARD/REAR BLOCKING ASSEMBLY" ON PAGE 80.
- ② SIDE FILL ASSEMBLY A (2 REQD). SEE THE DETAIL ON PAGE 22.
- ③ FILL MATERIAL, 4" WIDE BY 6'-9" LONG MATERIAL (AS REQD). NAIL THE FIRST PIECE TO THE REAR BLOCKING ASSEMBLY W/7 NAILS OF A SUITABLE SIZE (10d FOR 2" THICK MATERIAL). NAIL EACH ADDITIONAL PIECE TO THE PREVIOUS PIECE IN A SIMILAR MANNER. NOTE: MULTIPLE PIECES MAY BE LAMINATED TOGETHER FIRST AND THEN TOENAILED TO THE REAR BLOCKING ASSEMBLY. SEE THE "SOLID FILL DETAIL A" ON PAGE 74 AND THE "SOLID FILL DETAIL B" ON PAGE 75.
- ④ STRUT LEDGER, 2" X 4" X 6" (6 SHOWN - OPTIONAL). INSTALL IF DESIRED TO AID IN THE INSTALLATION OF SPANNER PIECES. NAIL TO THE FILL MATERIAL W/2-10d NAILS.
- ⑤ DOOR SPANNER, 4" X 4" MATERIAL, CUT TO A LENGTH THAT WILL PROVIDE FOR A DRIVE FIT (REF: 7'-1-3/8") (3 REQD). TOENAIL TO THE FILL MATERIAL W/2-12d NAILS AT EACH END. SEE THE "BEVEL-CUT" DETAIL ON PAGE 8 AND THE "SPANNER/FILL INSTALLATION" ON PAGE 76. NOTE THAT THESE PIECES ARE NOT REQUIRED IF THE SPACE BETWEEN THE REAR BLOCKING ASSEMBLY AND THE LOAD RETAINER IS NOT GREATER THAN 6".

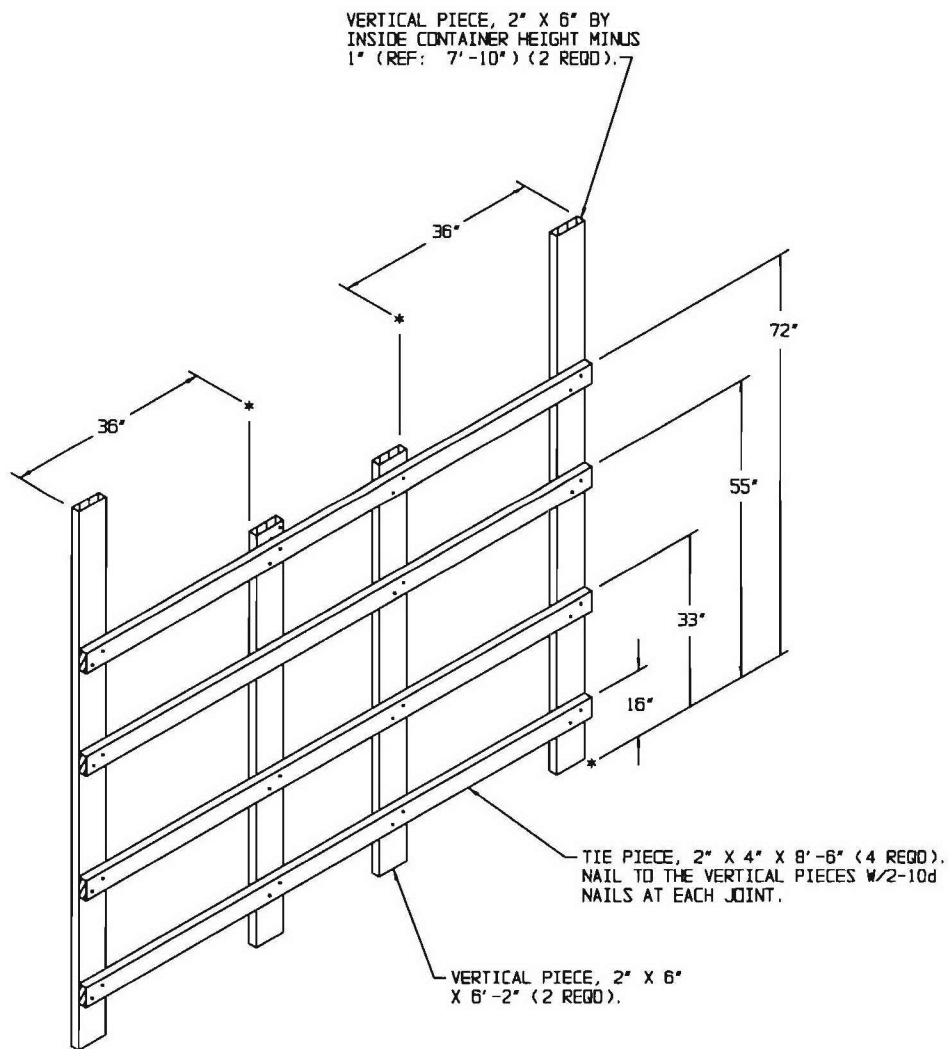
RECOMMENDED SEQUENTIAL LOADING PROCEDURES

1. PREFABRICATE TWO FORWARD/REAR BLOCKING ASSEMBLIES D AND TWO SIDE FILL ASSEMBLIES A.
2. INSTALL THE FORWARD BLOCKING ASSEMBLY D.
3. INSTALL ONE SIDE FILL ASSEMBLY A AND LOAD EIGHT PALLET UNITS.
4. REPEAT STEP 3.
5. INSTALL THE REAR BLOCKING ASSEMBLY D.
6. INSTALL THE FILL MATERIAL BETWEEN THE REAR BLOCKING ASSEMBLY AND THE LOAD RETAINERS.
7. INSTALL THE THREE DOOR SPANNER PIECES AND SIX STRUT LEDGERS.

BILL OF MATERIAL		
LUMBER	LINEAR FEET	BOARD FEET
2" X 4"	183	122
2" X 6"	178	178
4" X 4"	22	30
NAILS	NO. REQD	POUNDS
6d (2")	352	2-1/4
10d (3")	224	3-1/2
12d (3-1/4")	12	1/4
PLYWOOD, 1/2" - - - 96.05 SQ FT REQD - - 132.07 LBS		

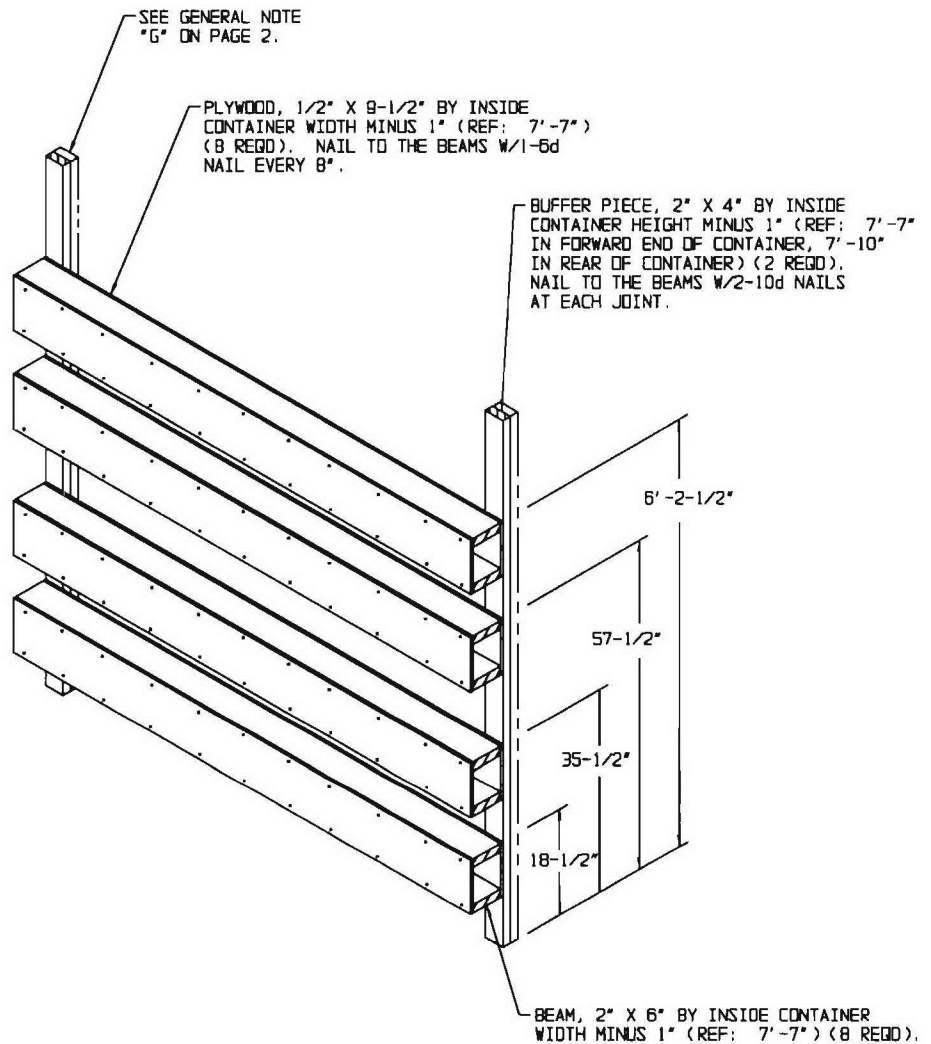
LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (APPROX)
PALLET UNIT - - - - -	16 - - - - -	43,664 LBS
DUNNAGE - - - - -	- - - - -	799 LBS
CONTAINER - - - - -	- - - - -	4,700 LBS
TOTAL WEIGHT - - - - -		49,163 LBS (APPROX)



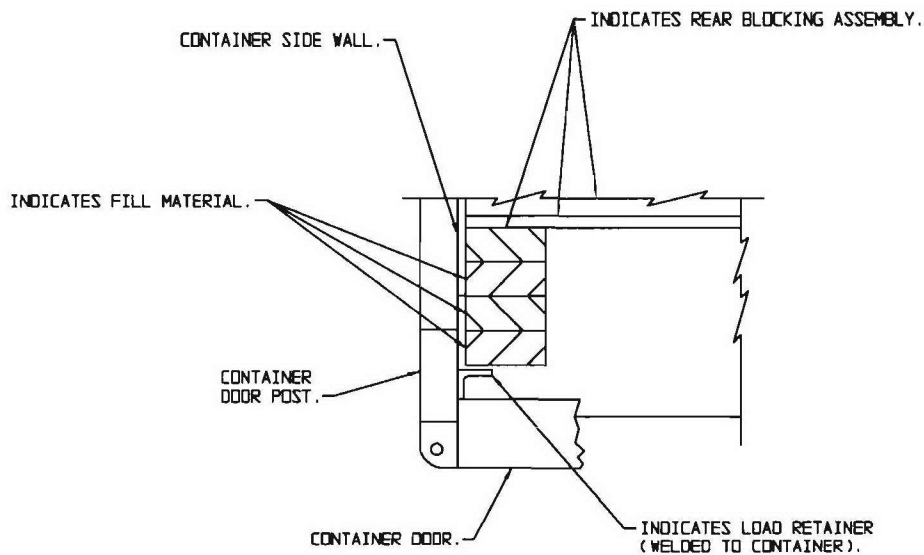
SIDE FILL ASSEMBLY A

FOR A ONE HIGH LOAD, ELIMINATE THE TOP TWO TIE PIECES,
AND SHORTEN THE 6'-2" VERTICAL PIECES APPROPRIATELY.



FORWARD/REAR BLOCKING ASSEMBLY D

NOTE: FOR ONE-HIGH LOAD, ELIMINATE THE TOP TWO BOX
BEAM ASSEMBLIES. A TWO LAYER LOAD MAY NOT EXCEED
45,600 POUNDS AND A ONE LAYER LOAD MAY NOT EXCEED
22,800 POUNDS.

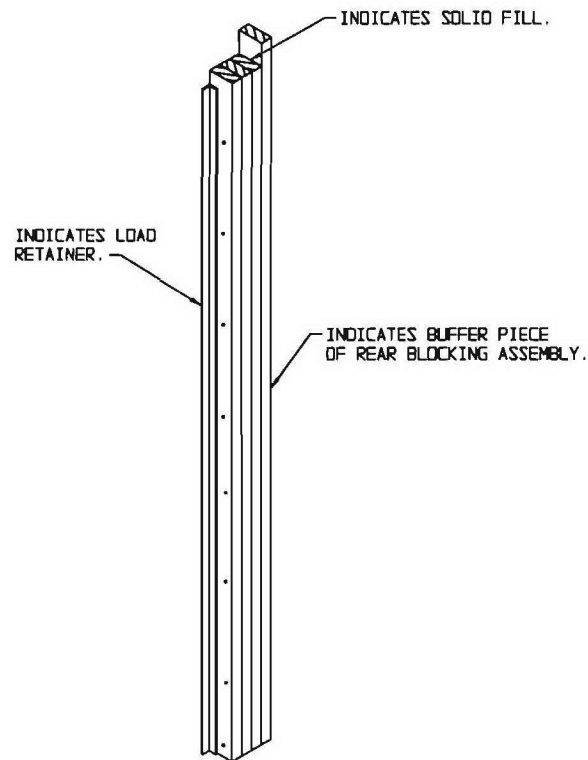


DETAIL A

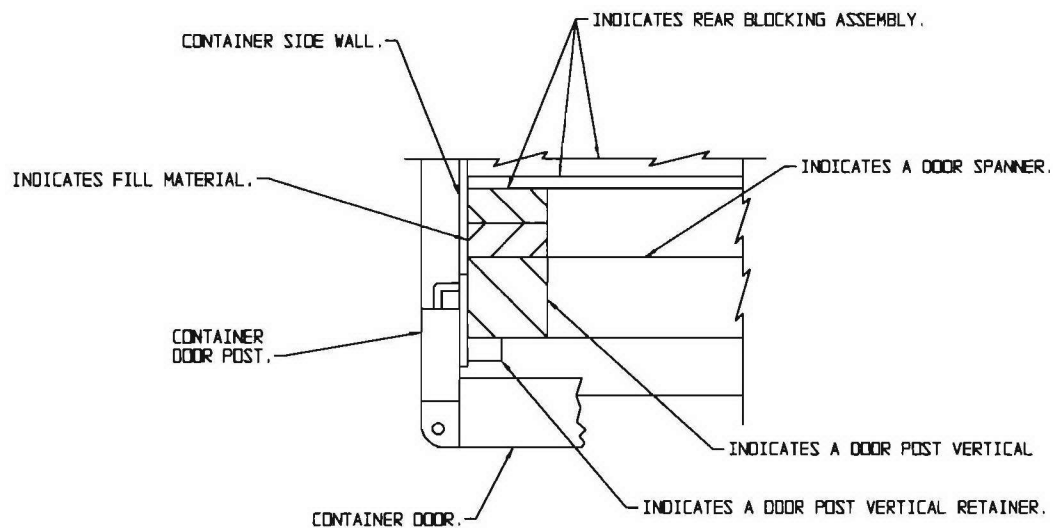
A PARTIAL PLAN VIEW OF THE LEFT REAR PORTION OF THE CONTAINER IS SHOWN DEPICTING THE PROPER POSITION OF THE FILL MATERIAL AND ADJACENT DUNNAGE PIECES.

SPECIAL NOTE:

WHEN ISO CONTAINERS ARE NOT EQUIPPED WITH PRE-WELDED LOAD RETAINERS, SUCH AS DEPICTED IN "DETAIL B" ON PAGE 75, DOOR POST VERTICALS, DOOR POST VERTICAL RETAINERS AND DOOR SPANNERS WILL BE REQUIRED FOR THE LOADS DEPICTED HEREIN. SEE PAGE 82 FOR DETAILS OF THE METAL DOOR POST VERTICAL RETAINER.



SOLID FILL DETAIL A

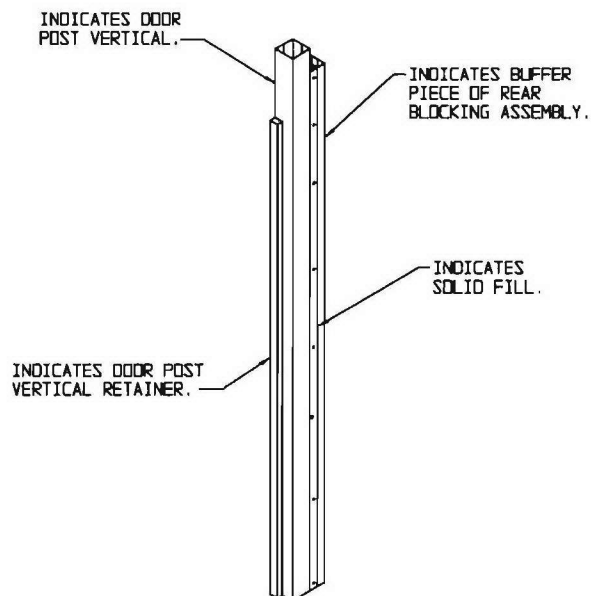


DETAIL B

A PARTIAL PLAN VIEW OF THE LEFT REAR PORTION OF THE CONTAINER IS SHOWN DEPICTING THE PROPER POSITION OF THE DOOR POST VERTICAL AND ADJACENT DUNNAGE PIECES.

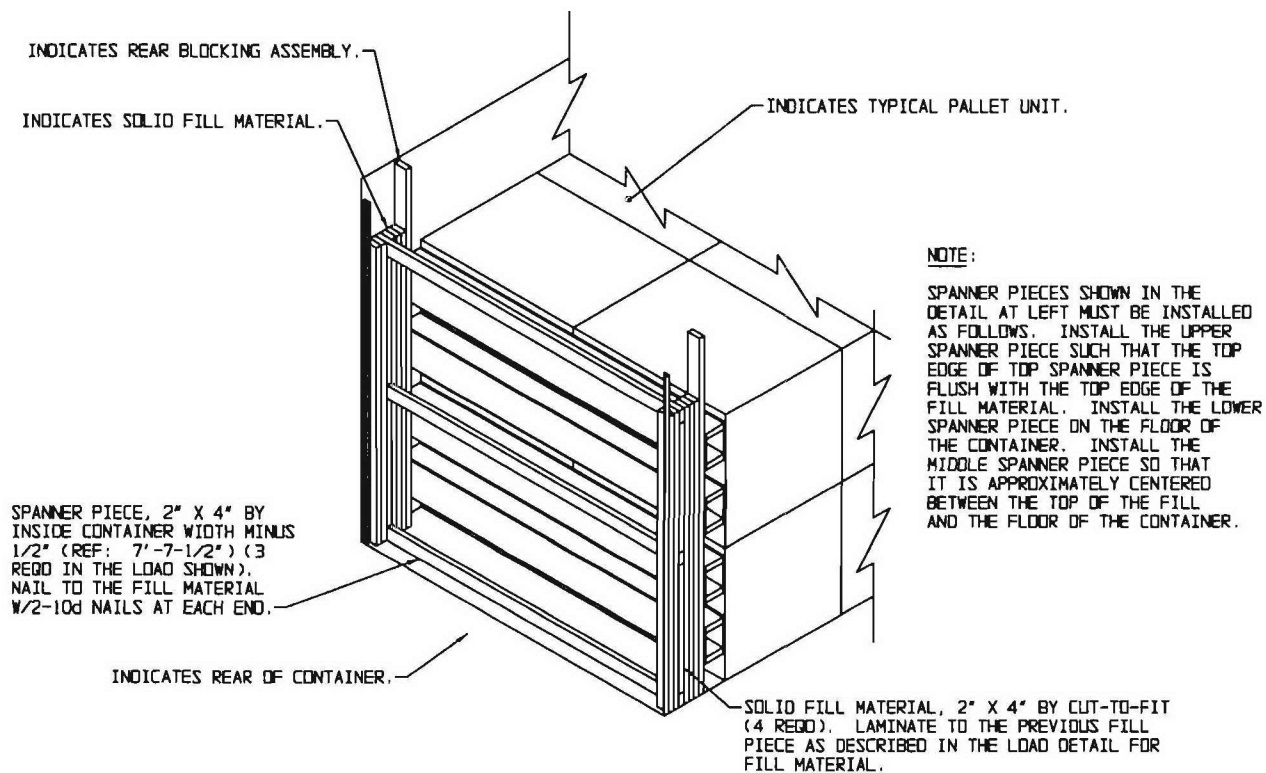
SPECIAL NOTE:

WHEN ISO CONTAINERS ARE EQUIPPED WITH PRE-WELDED LOAD RETAINERS, AS DEPICTED IN "DETAIL A" ON PAGE 74, THE DOOR POST VERTICALS, THE DOOR POST VERTICAL RETAINERS AND THE DOOR SPANNERS WILL BE ELIMINATED FROM THE LOADS DEPICTED HEREIN. ADDITIONAL FILL MATERIAL MUST BE ADDED, AS REQUIRED, TO FILL OUT THE VOID BETWEEN THE REAR BLOCKING ASSEMBLY AND THE LOAD RETAINER.



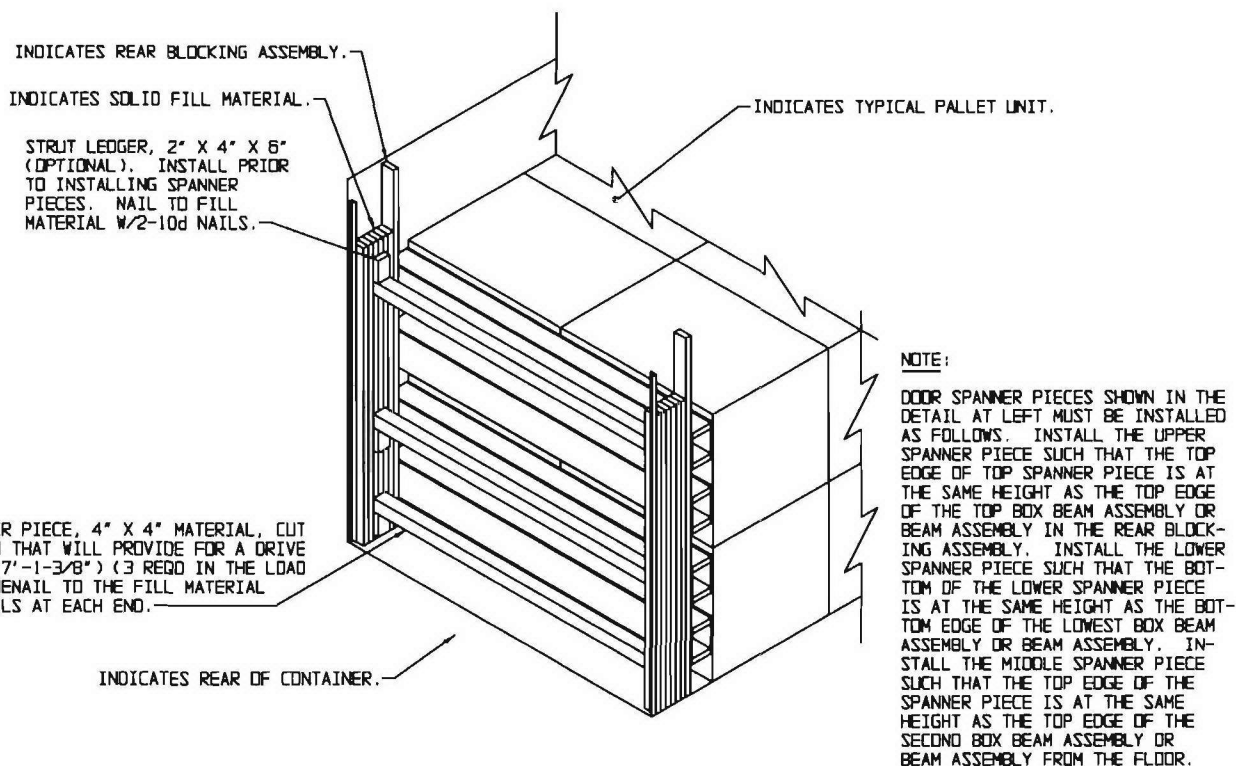
SOLID FILL DETAIL B

DOOR SPANNERS AND DOOR SPANNER LEDGERS HAVE BEEN OMITTED FOR CLARITY PURPOSES.



SPANNER/FILL INSTALLATION

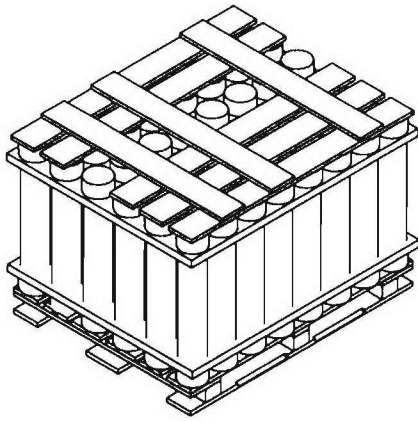
THE DETAILS ABOVE AND BELOW DEPICT THE PROCEDURES TO BE USED WHEN INSTALLING MORE THAN 6" OF SOLID FILL MATERIAL AT THE REAR OF THE LOAD. ONE SET OF THREE SPANNER PIECES AND FOUR CUT-TO-FIT FILL PIECES OR THREE DOOR SPANNER PIECES AND THE OPTIONAL STRUT LEDGERS MUST BE INSTALLED WHEN A REAR BLOCKING ASSEMBLY IS ASSEMBLED USING MORE THAN TWO BOX BEAM ASSEMBLIES. IF ONLY TWO OR LESS BOX BEAM ASSEMBLIES ARE USED IN THE REAR BLOCKING ASSEMBLY, ONLY TWO SPANNER PIECES OR TWO DOOR SPANNERS ARE REQUIRED. THE HEIGHT OF THE SOLID FILL PIECES USED SHOULD BE THE HEIGHT OF TOP OF THE UPPERMOST BEAM ASSEMBLY OR BOX BEAM ASSEMBLY IN THE REAR BLOCKING ASSEMBLY PLUS 6".



BOX CAR TEST SKETCH FOR MONOPACK TRANSPORTABILITY TESTING

THIS SKETCH DEPICTS A 50'-6" LONG BY 9'-2"
WIDE CONVENTIONAL BOXCAR LOAD WITH SIX
MONOPACK PALLET UNITS AND BALLIST LOAD
USING 40MM LINKED PALLET UNITS AND 40MM
METAL PALLET UNITS

SJMAC-DET
AUGUST 1, 2005



**SIMPLIFIED 120MM
MONOPACK PALLET UNIT**

DIMENSIONS: 44" X 54" X 36-1/2"

WEIGHT:

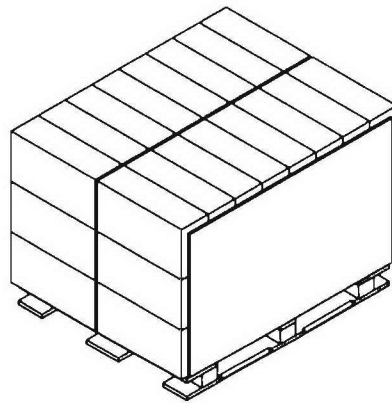
2,150 LBS APPROX. WITH IM BARRIERS

2,020 LBS APPROX. WITHOUT IM BARRIERS

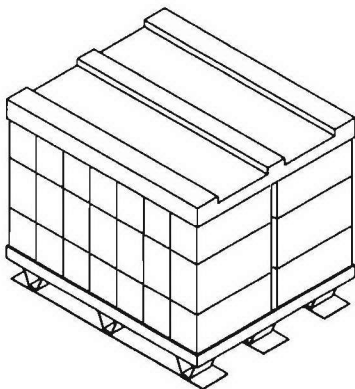
DIMENSIONS: 42-1/2" X 51" X 35-1/4"

WEIGHT:

2,575 LBS APPROX.



**SIMPLIFIED 40MM LINKED PALLET
UNIT**

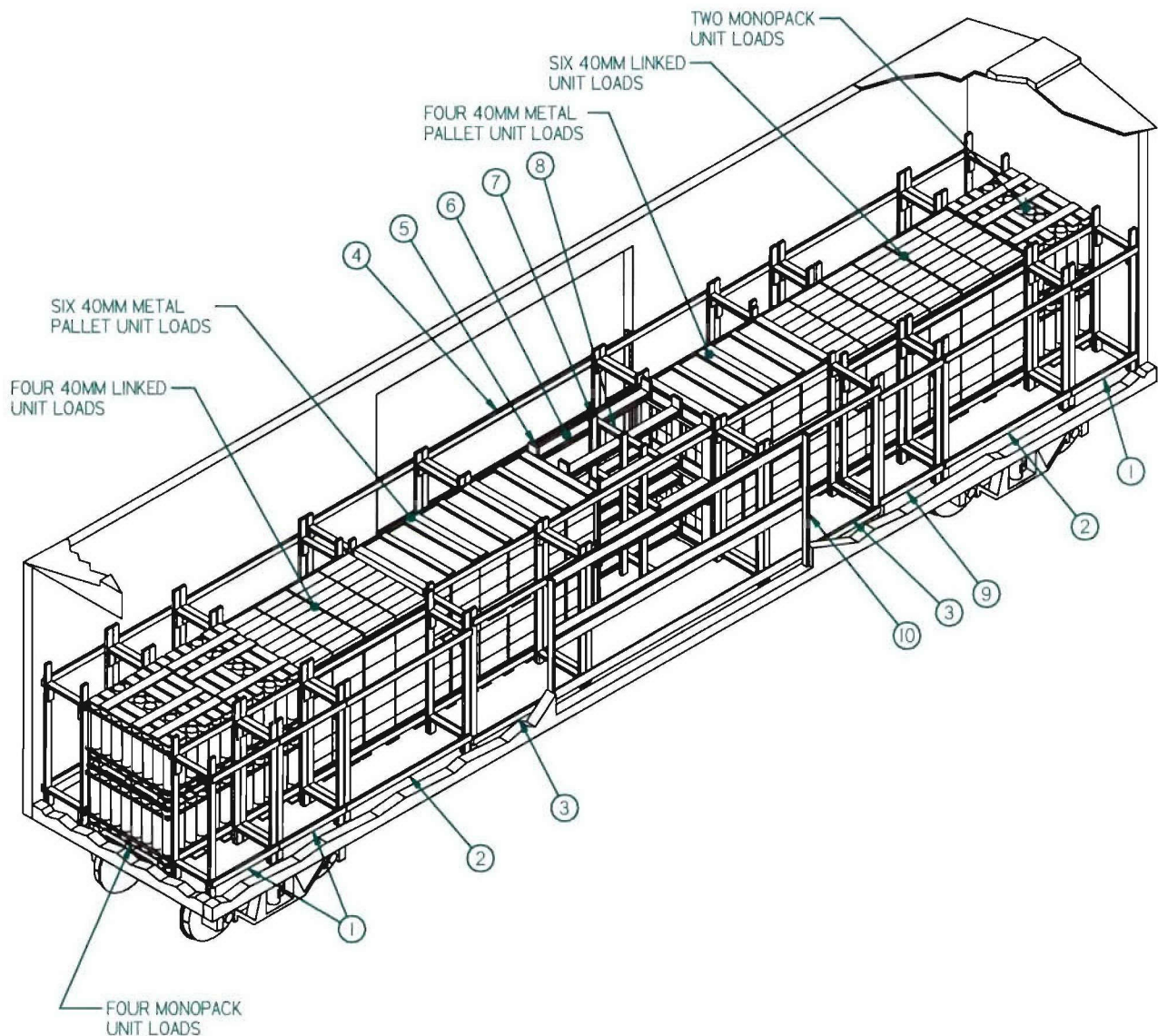


**SIMPLIFIED 40MM METAL
PALLET UNIT**

DIMENSIONS: 37-5/8" X 45-1/2" X 38"

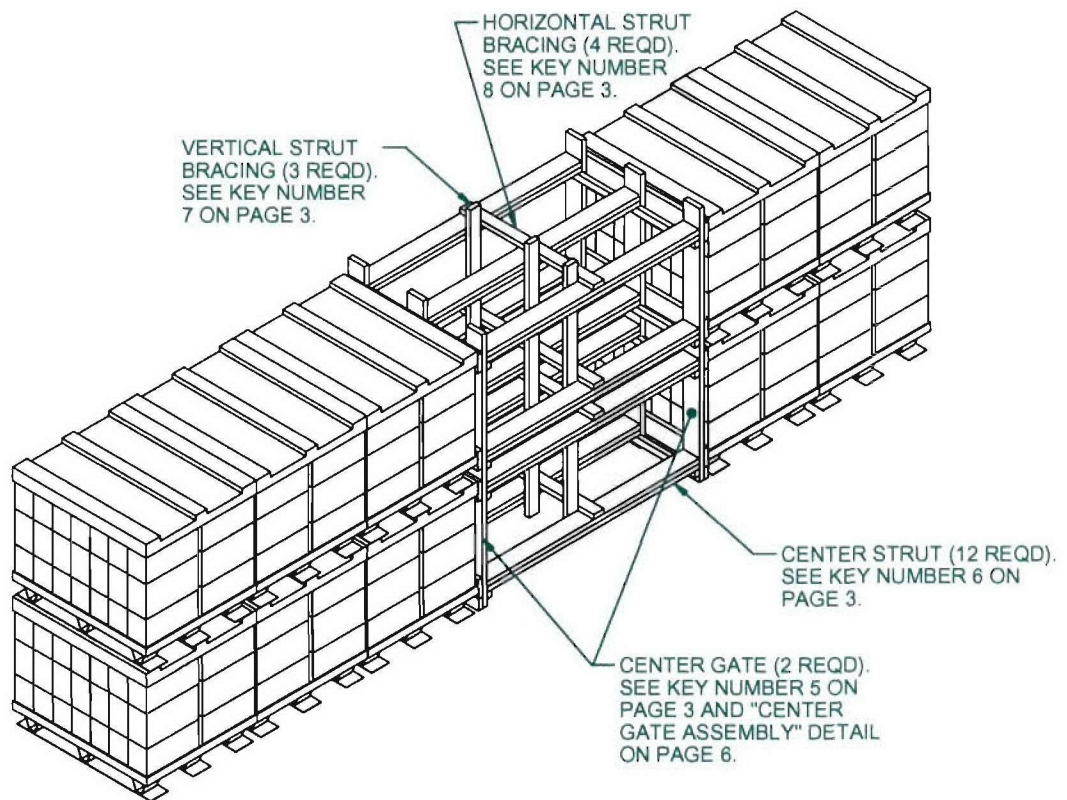
WEIGHT:

2,500 LBS APPROX

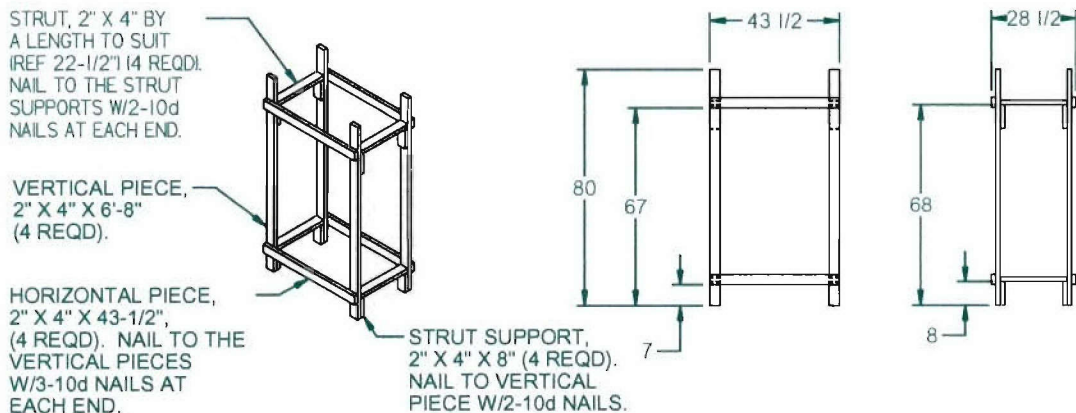


KEY NUMBERS

- ① MONOPACK CRIB ASSEMBLY (6 REQD). SEE THE "MONOPACK CRIB ASSEMBLY" DETAIL ON PAGE 4.
- ② 40MM LINKED CRIB ASSEMBLY A (4 REQD). SEE THE "40MM LINKED CRIB ASSEMBLY A" DETAIL ON PAGE 4.
- ③ 40MM METAL PALLET CRIB ASSEMBLY A (4 REQD). SEE THE "40MM METAL PALLET CRIB ASSEMBLY A" DETAIL ON PAGE 5.
- ④ 40MM METAL PALLET CRIB ASSEMBLY B (2 REQD). SEE THE "40MM METAL PALLET CRIB ASSEMBLY B" DETAIL ON PAGE 5.
- ⑤ CENTER GATE (2 REQD). SEE THE "CENTER GATE" DETAIL ON PAGE 5.
- ⑥ CENTER STRUT (12 REQD), 2" X 6" BY CUT TO FIT (5' - 3-3/8" REF) (DOUBLED). LAMINATE W/1-10d NAIL EVERY 6". TOENAIL TO PIECES MARKED ③ W/2-16d NAILS AT EACH END. SEE "CENTER GATE ASSEMBLY" DETAIL ON PAGE 4.
- ⑦ VERTICAL STRUT BRACING, 2" X 4" X 6'-8" (3 REQD). NAIL TO THE CENTER STRUTS W/3-10d NAILS AT EACH JOINT. SEE "CENTER GATE ASSEMBLY" DETAIL ON PAGE 4.
- ⑧ HORIZONTAL STRUT BRACING, 2" X 4" X 45-1/2" (4 REQD). NAIL TO THE CENTER STRUTS W/3-10d NAILS AT EACH JOINT. SEE "CENTER GATE ASSEMBLY" DETAIL ON PAGE 4.
- ⑨ 40MM LINKED CRIB ASSEMBLY B (2 REQD). SEE THE "40MM LINKED CRIB ASSEMBLY B" DETAIL ON PAGE 6.
- ⑩ DOORWAY PROTECTION (2 REQD). SEE THE "DOORWAY PROTECTION" DETAIL ON PAGE 6. NAIL TO THE DOOR POSTS W/12d NAILS.

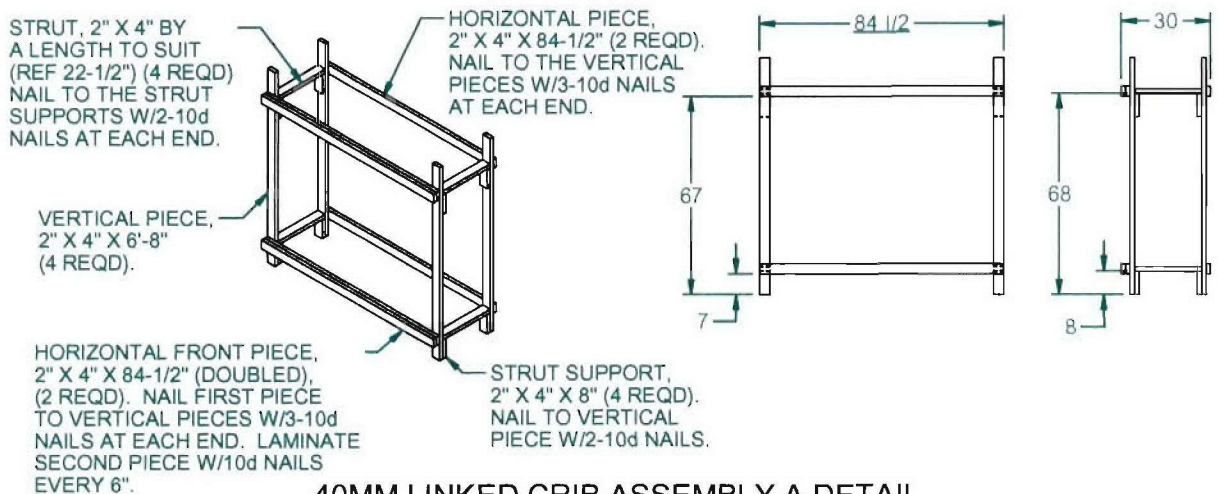


CENTER GATE ASSEMBLY DETAIL



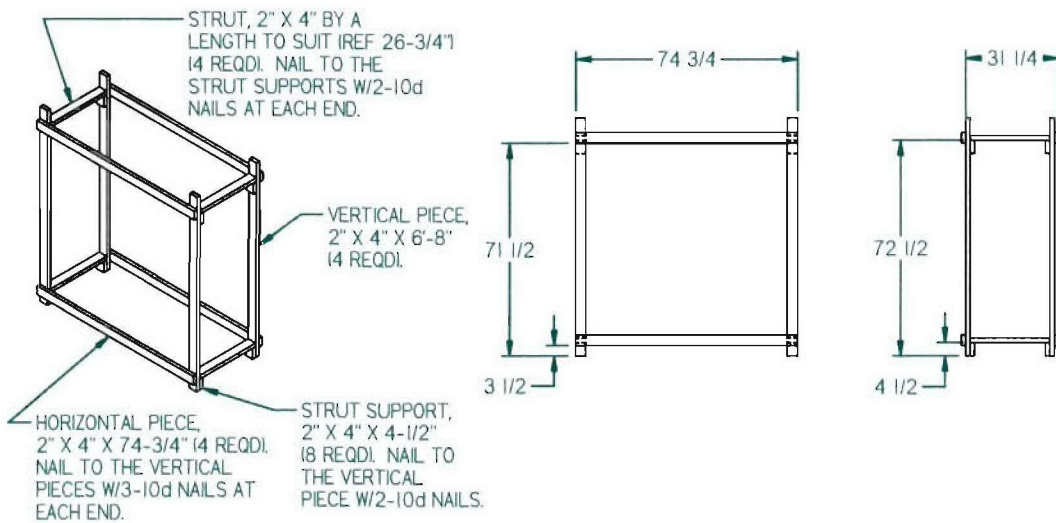
MONOPACK CRIB ASSEMBLY DETAIL

(6 REQD)

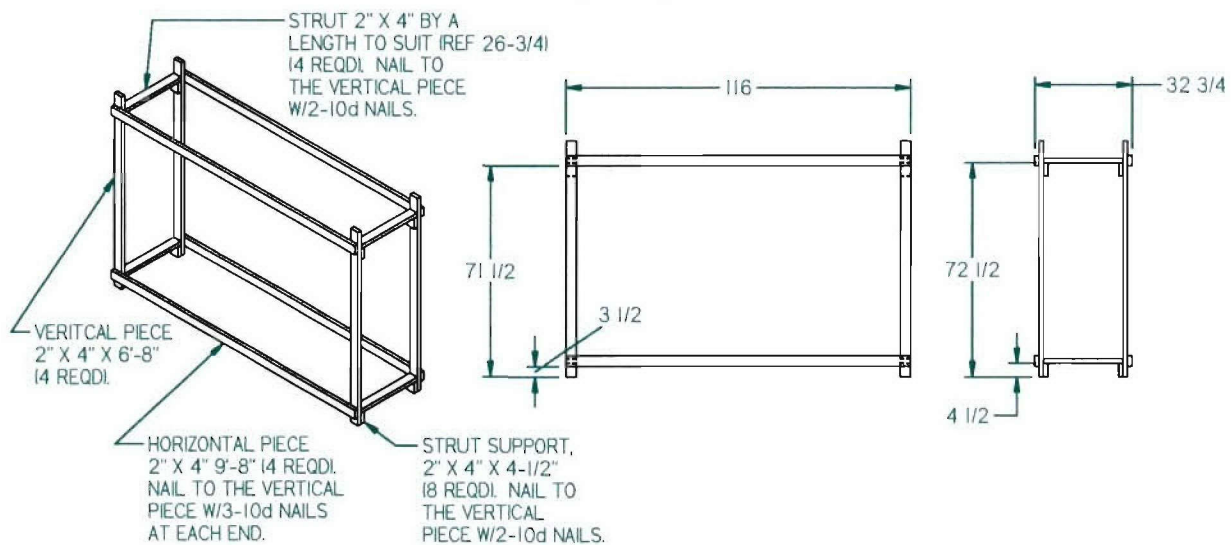


40MM LINKED CRIB ASSEMBLY A DETAIL

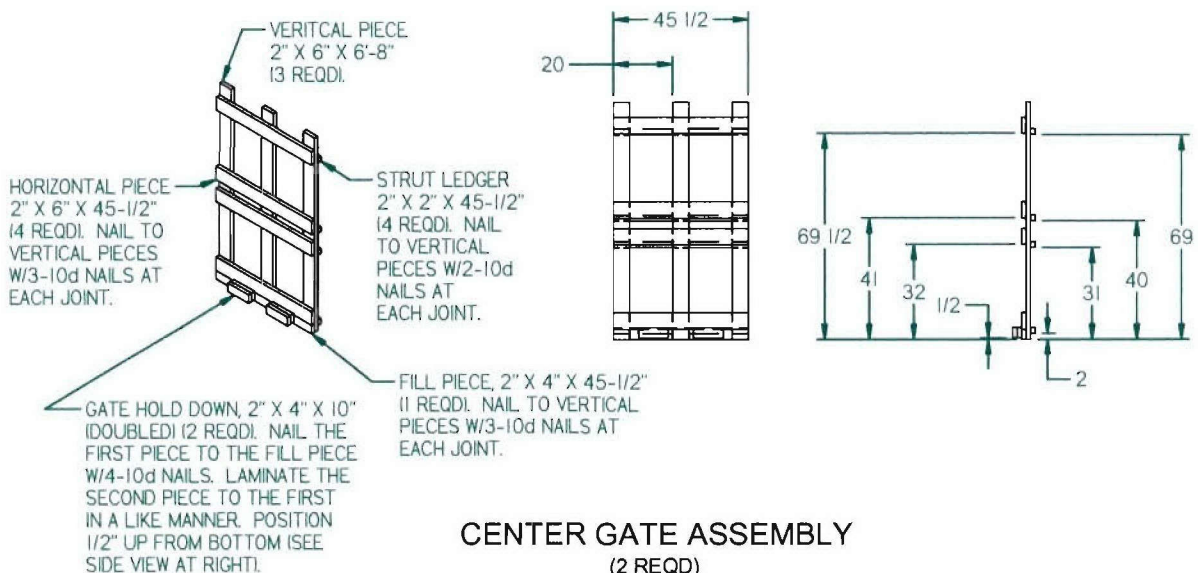
(4 REQD)



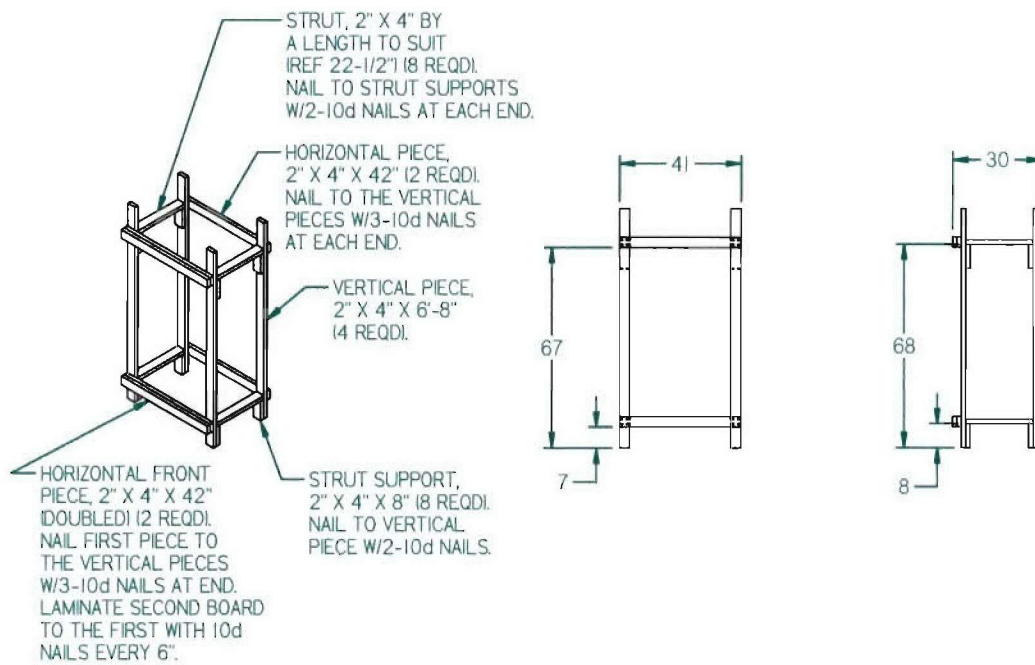
40MM METAL PALLET CRIB ASSEMBLY A
(4 REQD)



40MM METAL PALLET CRIB ASSEMBLY B
(2 REQD)

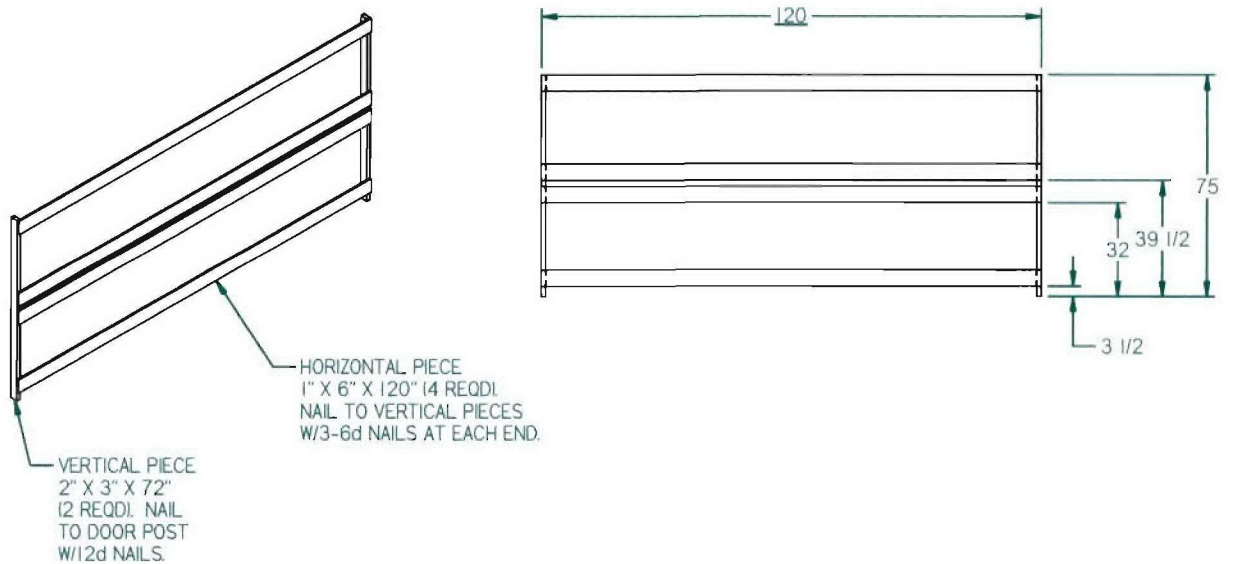


CENTER GATE ASSEMBLY
(2 REQD)



40MM LINKED CRIB ASSEMBLY B DETAIL

(2 REQD)



DOORWAY PROTECTION ASSEMBLY DETAIL

(2 REQD)

BILL OF MATERIALS		
LUMBER	LINEAR FEET	BOARD FEET
1 X 6	112	56
2 X 2	31	11
2 X 3	24	12
2 X 4	1169	780
2 X 6	71	71